GE Healthcare

Solar™ 8000M/i patient monitor

Service Manual

Software Version 5

Solar™ 8000M/i patient monitor
English
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2026264-042C (paper)
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NOTE: The information in this manual applies to Solar 8000i and Solar 8000M Patient Monitors. Due to continuing product innovation, specifications in this manual are subject to change without notice.

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1 Introduction

Manual information

Revision history

Each page of the document has the document part number and revision letter at the bottom of the page. The revision letter changes whenever the document is updated.

Revision	Comment
A	Initial release
B	Updated document with editorial changes.
C	Updated document with cpu and related hardware changes.

Intended use

This manual supplies technical information for service representatives and technical personnel so they can maintain the equipment to the assembly level. Use it as a guide for maintenance and electrical repairs considered field repairable. Where necessary the manual identifies additional sources of relevant information and technical assistance.

See the operator's manual for the instructions necessary to operate the equipment safely in accordance with its function and intended use.

Intended audience

This manual is intended for service representatives and technical personnel who maintain, troubleshoot, or repair this equipment.

Ordering manuals

A paper copy of this manual will be provided upon request. Contact your local GE representative and request the part number on the first page of the manual.

Safety information

Responsibility of the manufacturer

GE is responsible for the effects of safety, reliability, and performance only if:

- Assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by GE.
- The electrical installation of the relevant room complies with the requirements of the appropriate regulations.
- The equipment is used in accordance with the instructions for use.

General

This device is intended for use under the direct supervision of a licensed health care practitioner.

This device is not intended for home use.

Federal law restricts this device to be sold by or on the order of a physician.

Contact GE for information before connecting any devices to the equipment that are not recommended in this manual.

Parts and accessories used must meet the requirements of the applicable EN 60601 series safety standards, and/or the system configuration must meet the requirements of the EN 60601-1-1 medical electrical systems standard.

Periodically, and whenever the integrity of the device is in doubt, test all functions.

The use of *accessory* equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include:

- use of the accessory in the *patient vicinity*; and
- evidence that the safety certification of the *accessory* has been performed in accordance to the appropriate EN 60601-1 and/or EN 60601-1-1 harmonized national standard.

If the installation of the equipment, in the USA, will use 240V rather than 120V, the source must be a center-tapped, 240V, single-phase circuit.

Warnings, cautions, and notes

The terms danger, warning, and caution are used throughout this manual to point out hazards and to designate a degree or level or seriousness. Familiarize yourself with their definitions and significance.

Hazard is defined as a source of potential injury to a person.

DANGER indicates an imminent hazard which, if not avoided, will result in death or serious injury.

WARNING indicates a potential hazard or unsafe practice which, if not avoided, could result in death or serious injury.

CAUTION indicates a potential hazard or unsafe practice which, if not avoided, could result in minor personal injury or product/property damage.

NOTE provides application tips or other useful information to assure that you get the most from your equipment.

Equipment symbols

NOTE: Some symbols may not appear on all equipment.

ATTENTION: Consult accompanying documents.

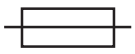
CAUTION: To reduce the risk of electric shock, do *not* remove cover. Refer servicing to qualified service personnel.

NOTE: The rating of protection against electric shock (indicated by symbol for CF or BF) is achieved only when used with patient applied parts recommended by GE.

TYPE CF APPLIED PART: Isolated (floating) applied part suitable for intentional external and internal application to the patient including direct cardiac application. “Paddles” outside the box indicate the applied part is defibrillator proof.
[Medical Standard Definition:] F-type applied part (floating/isolated) complying with the specified requirements of IEC/EN/UL 60601-1 Medical Standards to provide a higher degree of protection against electric shock than that provided by type BF applied parts.

TYPE BF APPLIED PART: Isolated (floating) applied part suitable for intentional external and internal application to the patient excluding direct cardiac application. “Paddles” outside the box indicate the applied part is defibrillator proof.
[Medical Standard Definition:] F-type applied part (floating/isolated) complying with the specified requirements of IEC/EN/UL 60601-1 Medical Standards to provide a higher degree of protection against electric shock than that provided by type B applied parts.

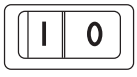
TYPE B APPLIED PART: Non-isolated applied part suitable for intentional external and internal application to the patient excluding direct cardiac application.
[Medical Standard Definition:] Applied part complying with the specified requirements of IEC/EN/UL 60601-1 Medical Standards to provide protection against electric shock, particularly regarding allowable leakage current.



Fuse

Equipotential Stud: A ground wire from another device can be tied here to ensure the devices share a common reference.

Alternating current (AC)



Power; I = ON; O = OFF

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Medical Equipment

With respect to electric shock, fire and mechanical hazards only in accordance with UL 60601-1, CAN/CSA C22.2 NO. 601.1, IEC 60601-1, IEC 60601-2-27, IEC 60601-2-30, IEC 60601-2-34, and IEC 60601-2-49.

This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

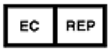
2006-04

This symbol indicates the date of manufacture of this device. The first four digits identify the year and the last two digits identify the month.

Non-ionizing electromagnetic radiation: To indicate elevated, potentially dangerous, levels of non-ionizing radiation. Note - In case of application in a warning sign the rules according to ISO 3864-1 shall be adhered to.

IEC 60878 note: See safety sign ISO 7010 - W005 “Warning, non-ionizing radiation”.

Manufacturer name and address.



European authorized representative.

     	NOTE The following symbols (required by China law *only*) are representative of what you may see on your equipment. The number in the symbol indicates the EFUP period in years, as explained below. Check the symbol on your equipment for its EFUP period. This symbol indicates the product contains hazardous materials in excess of the limits established by the Chinese standard SJ/T11363-2006 *Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products*. The number in the symbol is the Environment-friendly User Period (EFUP), which indicates the period during which the toxic or hazardous substances or elements contained in electronic information products will not leak or mutate under normal operating conditions so that the use of such electronic information products will not result in any severe environmental pollution, any bodily injury or damage to any assets. The unit of the period is “Year”. In order to maintain the declared EFUP, the product shall be operated normally according to the instructions and environmental conditions as defined in the product manual, and periodic maintenance schedules specified in Product Maintenance Procedures shall be followed strictly. Consumables or certain parts may have their own label with an EFUP value less than the product. Periodic replacement of those consumables or parts to maintain the declared EFUP shall be done in accordance with the Product Maintenance Procedures. This product must not be disposed of as unsorted municipal waste, and must be collected separately and handled properly after decommissioning.
	This symbol indicates that this electronic information product does not contain any toxic or hazardous substance or elements above the maximum concentration value established by the Chinese standard SJ/T11363-2006, and can be recycled after being discarded, and should not be casually discarded.

Service information

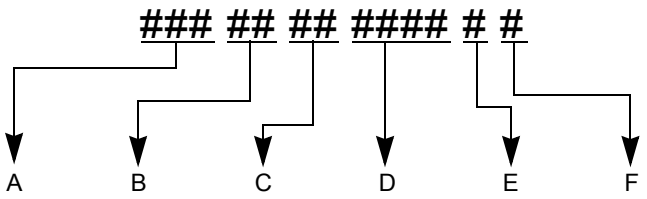
Service requirements

Follow the service requirements listed below.

- Refer equipment servicing to GE authorized service personnel only.
- Any unauthorized attempt to repair equipment under warranty voids that warranty.
- It is the user's responsibility to report the need for service to GE or to one of their authorized agents.
- Failure on the part of the responsible individual, hospital, or institution using this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.
- Regular maintenance, irrespective of usage, is essential to ensure that the equipment will always be functional when required.

Equipment identification

Every GE device has a unique serial number for identification. A sample of the information found on a serial number label is shown below.



	Description
A	product code
B	year manufactured
C	fiscal week manufactured
D	production sequence number
E	manufacturing site
F	miscellaneous characteristic

2 Equipment overview

System components

Solar 8000M/i patient monitoring system

The Solar 8000M/i patient monitoring system consists of the following standard components:

- Solar 8000M/i processing unit
- Display
- Keypad and/or remote control
- Two possible acquisition devices:
  - Tram-rac housing with acquisition module(s)
  - Patient Data Module (also referred to as PDM)

Optional components include:

- iPanel™ computer
- Clinical Information Center (central station)
- Remote display, VGA and DFP

  NOTE

  Available on Solar 8000M and Solar 8000i patient monitors with dual display capability.

- Printer PRN 50/PRN 50-M
- Unity Network™ ID connectivity device

Solar 8000M/i patient monitor

The patient monitor consists of a Solar 8000M/i processing unit with compatible display purchased from GE or another vendor.

The processing unit is the center of the Solar 8000M/i patient monitoring system. It provides the user controls, the processors to communicate with various patient monitoring modules, and it analyzes patient data. It can display up to eight different waveforms at one time. System software may be updated using a laptop computer connected to the Solar 8000M/i processing unit or the Unity Network or from a Clinical Information Center (CIC) on the Unity Network.

001C

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iPanel computer

The iPanel computer is a self contained medical grade computer with flat panel display for use in the patient area. The iPanel contains the iPanel software that provides one touch access to patient data on the enterprise network. The iPanel application is compatible with the following patient data web portals:

- Centricity CIV
- Centricity CV Cardiology Web
- MUSE CV Web
- Centricity Enterprise Web

037A

UnityView remote display controller

The UnityView remote display controller consists of a remote display controller with a compatible display purchased from GE or another vendor. The controller connects to the Unity Network and may be configured to display any patient waveforms broadcasted on the network for better visibility as a remote full-view display, or as an in-room telemetry display.

Tram-rac housing

The Tram-rac housing (remote acquisition case) acquires patient data for the patient monitor. There are two Tram-rac housings available for the monitor:

- Tram-rac 2 housing — holds one Tram module.
- Tram-rac 4A housing — holds one Tram module and two additional single-high modules.

See the Tram-rac Housing Service Manual for additional information. Shown below is a Tram-rac 4A housing with a Tram module and two single parameter modules inserted.

005B

Patient Data Module (PDM)

The Patient Data Module (PDM) acquires patient data for the patient monitor. See the Patient Data Module service manual for additional information.

061A

Connectivity devices

The Unity Network ID connectivity device acquires digital data from eight individually isolated serial ports. The data is collected from up to eight peripheral devices (not necessarily manufactured by GE), then the device transmits the formatted data to the Solar 8000M/i patient monitor. See the appropriate connectivity device service manual for additional information.

002B

PRN 50/PRN 50-M digital writer

The PRN 50/PRN 50-M digital writer thermally records patient data on a paper strip. Any parameter or trace that can be monitored on a monitor can be graphed by the writer. Graphs initiate automatically when an alarm is activated, or they can be initiated manually from the monitor.

003C

NOTE

The PRN 50-M digital writer is an M-Port device. To make an AutoPort device (such as PRN 50) M-Port compatible, use the AutoPort to M-Port adapter, pn 2001973-001.

Laser printer

An optional laser printer can be connected directly to the monitor via one of the **M-Port**s. The laser printer must have a serial port, and an interface adapter is required for the cable between the laser printer and the monitor. Refer to the instructions provided in Laser Printer Support Kit, pn 2013421-001, for details on the interface adapter and installing a serial card in a laser printer.

WARNINGS

SHOCK HAZARD. Laser printers are UL 60950/EN 60950 certified equipment, which may not meet the leakage current requirements of patient care equipment. This equipment must not be located in the patient vicinity unless the medical system standard EN 60601-1-1 is followed.

Do not connect a laser printer to a multiple portable socket outlet (MPSO) supplying patient care equipment. The use of an MPSO for a system will result in an enclosure leakage current equal to the sum of all the individual earth leakage currents of the system if there is an interruption of the MPSO protective earth conductor.

Remote control or keypad

The remote control or keypad provides all patient monitor controls on a portable component with a **TRIM KNOB** control, and allows the user to operate the patient monitor from across a room. Eighteen hard keys are configured for adult, neonatal, or operating room applications. The keypad can be mounted on the display or on a separate holster that has various mounting configurations.

004B

Remote displays

Depending on your Solar 8000M/i configuration, there are up to two VGA (CRT/analog flat panel) ports and two DFP (digital flat panel) ports for remote viewing.

Device compatibility

The tables in this section are current as of the publication date of this manual and are subject to change. For current information, contact your Service or Sales Representative.

Acquisition modules

The Solar 8000M/i patient monitor is compatible with the following acquisition modules.

Patient Data Module (Nellcor OxiMax SpO_2)
Patient Data Module (Masimo SpO_2)
SvO2 Module
Dual Temp Module, Series 700
Dual Temp Module, Series 400
Dual BP Module
BP Module
BP/Dual Temp Module
GE SpO2 Module
Masimo SET SpO2 Module
Capnostat Mainstream EtCO2 Module
Capnostat Mainstream Module
Capnostat Dual CO2 Module
Pryon Mainstream Module
Pryon Sidestream Module
SAM Module
SAM80 Module
Tram Module w/ECG, Resp, CO, 2 BP, NIBP, SpO2
Tram Module w/ECG, Resp, CO, 3 BP, NIBP, SpO2
Tram Module w/ECG, Resp, CO, 4 BP, SpO2
Tram Module w/ECG, Resp, CO, NIBP, SpO2
Tram Module w/ECG, Resp, CO, 4 BP, NIBP, SpO2 (GE)
Tram Module w/ECG, Resp, CO, 4 BP, NIBP, SpO2 (Nellcor)
Tram Module w/ECG, Resp, CO, 4 BP, NIBP, SpO2 (Nellcor OxiMax)
Tram Module w/ECG, Resp, CO, 4 BP, NIBP, SpO2 (Masimo)
Tram Module w/ECG, Resp, CO, SpO2 (GE)
Tram Module w/ECG, Resp, CO, SpO2 (Nellcor)
Tram Module w/ECG, Resp, CO, SpO2 (Nellcor OxiMax)

Tram Module w/ECG, Resp, CO, SpO2 (Masimo)
tcpO2/pCO2 Module
Respiratory Mechanics Module
Impedance Cardiograph Module

Peripheral devices

The Solar 8000M/i patient monitor is compatible with the following peripheral devices.

Device	Interface
Solar 8000M/i Remote	M-Port
Solar 8000M/i Keypad	M-Port
PRN 50	M-Port with M-Port compatible PRN50
RAC 4A Comm	TRAM-NET
RAC 4A DAS	TRAM-NET
RAC 2	TRAM-NET
Unity Network ID	M-Port
RM Module	M-Port with M-Port compatible RM module
Serial download	RS-232 1
Elo Touchscreen	RS-232 2
Remote Alarm	M-Port
Laser printer	M-Port
iPanel Computer	RS-232 1[1]

1. Solar 8000i patient monitor only.

Unity Network devices

The Solar 8000M/i patient monitor is compatible with the following Unity Network devices.

Device
ADU/Pager LAN
ApexPro
Aware Gateway
CDT-LAN
CIC
CIC Pro C
Dash 2000
Dash 3000/4000/5000
Eagle 3000
Eagle 4000
HL7 Outbound
ICMMS/Service Web
StatView
iPanel
Impact Pager
Managed Care

Device
MARS 5000/8000
MUSE
Octacomm
QS
RSVP
Solar 7000/8000
Solar 8000M
Solar 9000/9500
ST Guard
Tramscope 12
Auto View
CO2 Module
Transcutaneous Module
Unity Network ID interface
Unity Network IS Patient Viewer
Unity Network Patient Data Server

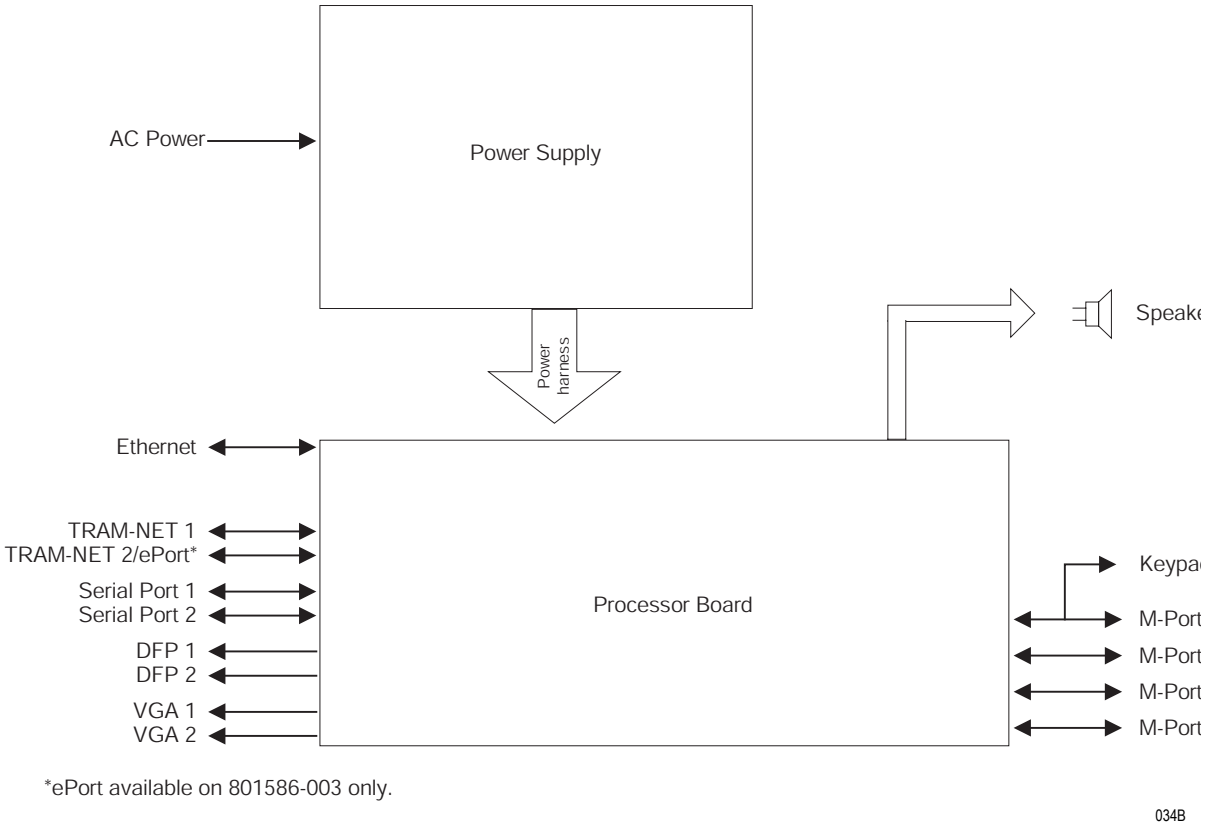
Interfacing with other peripheral devices

The Solar 8000M/i patient monitor can interface with other peripheral bedside monitoring devices through an Unity Network ID connectivity device. For a list of supported devices, see the Unity Network Interface Device (ID) Service Manual.

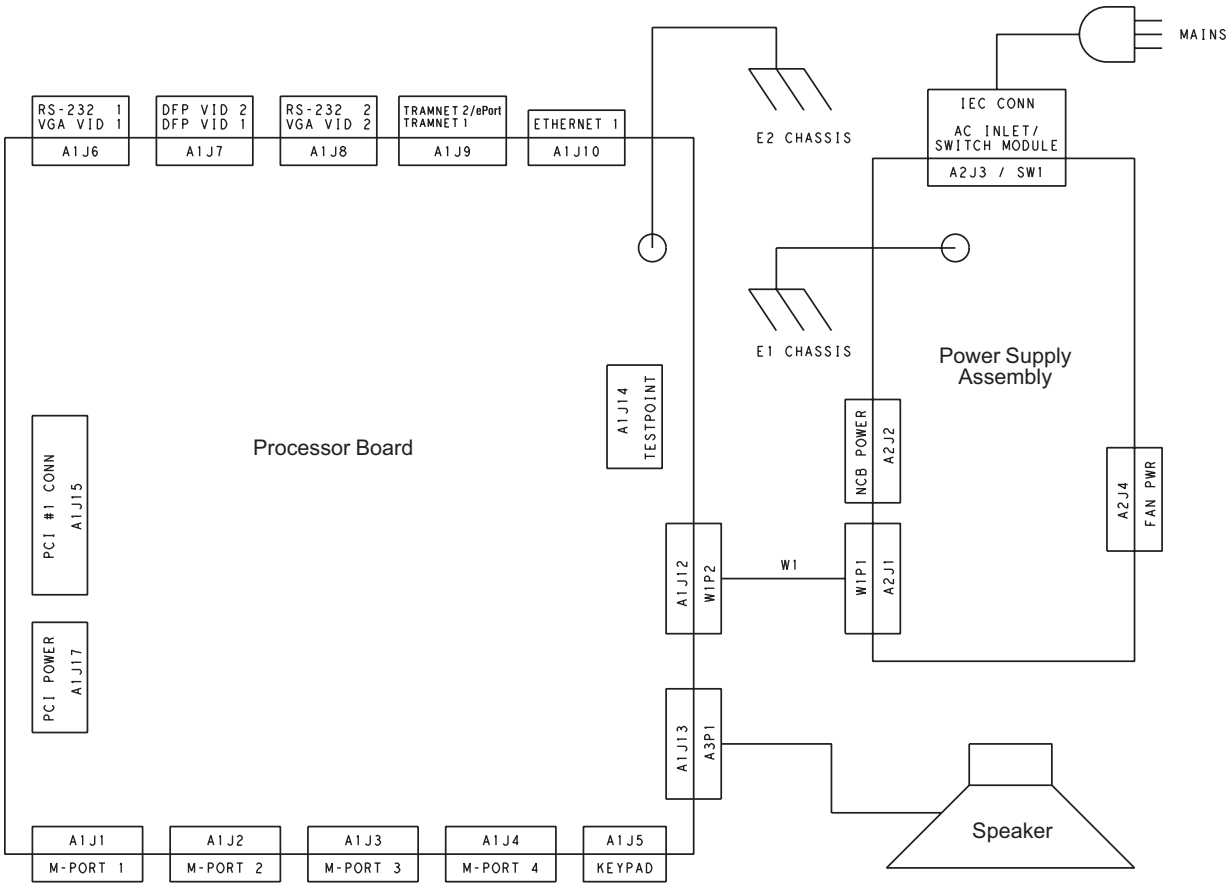
Theory of operation

The Solar 8000M/i patient monitor consists of a processor board, a power supply board, and a speaker. Software running on the processor board processes incoming data, services the communication channels and performs the general functions. System software may be updated using a laptop computer connected to the Solar 8000M/i processing unit or the Unity Network or from a Clinical Information Center (CIC) on the Unity Network.

The following theory of operation provides an overview of the various functional circuit boards in the monitor.



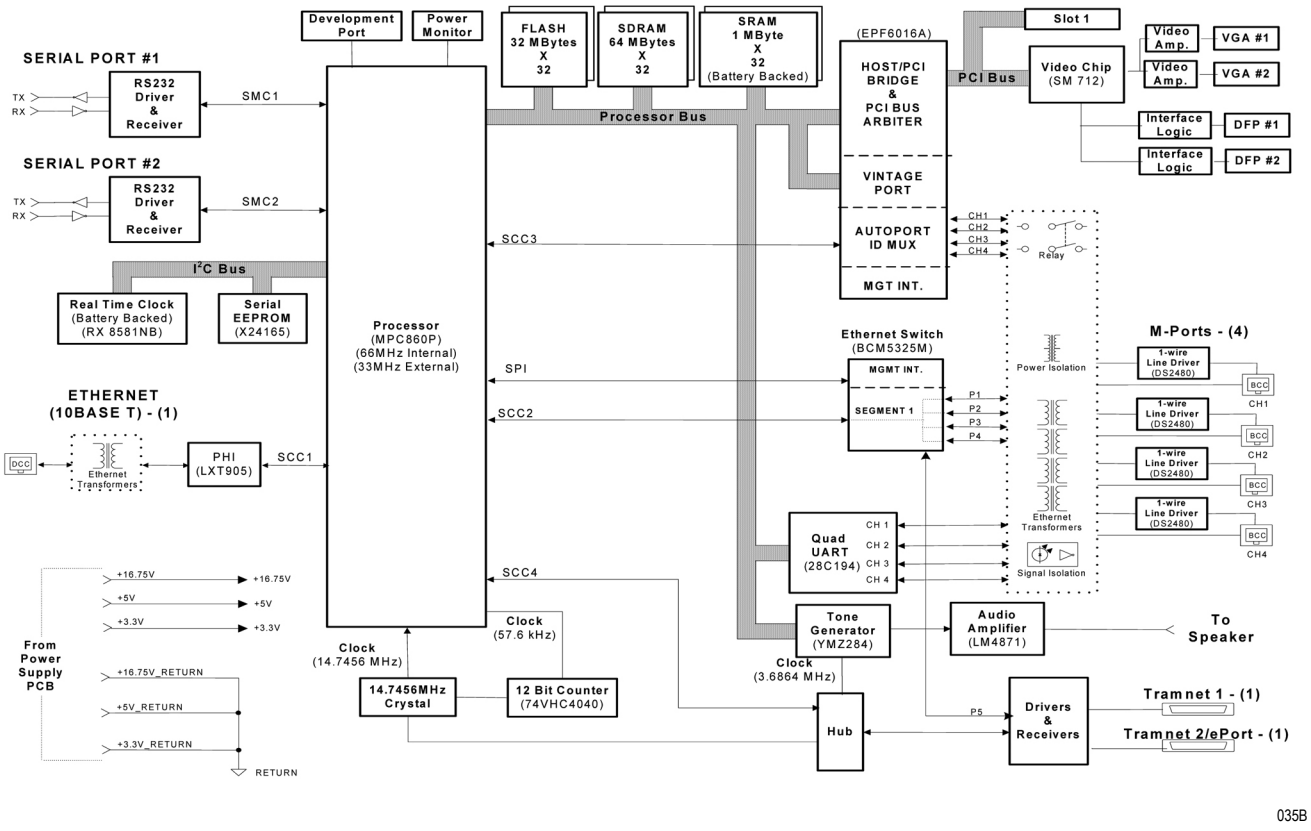
Block diagram of internal connections



036B

Processor board

The processor board processes acquired data for the generation of displayed information, audible alarms, and supports communication channels for the acquisition system, serial peripherals and the Unity Network.



035B

Core processing system

The core processing system of the processor board is the microprocessor, the memory subsystem and the peripheral set.

The microprocessor

The Motorola PowerPC MPC860P, operating internally at 66.66 MHz and 33.33 MHz externally, is the microprocessor used in the Solar 8000M/i processor PCB. The MPC860P consists of a PowerPC core with a System Interface Unit (SIU) and Communications Processor Module (CPM).

The main facilities integrated into the MPC860P include:

- PowerPC Core including:
  - 16k of Dual ported RAM for registers and microcode
  - A Memory Management Unit (MMU)
  - 16 kByte Instruction Cache
  - 8 kByte Data Cache
- System Integration Unit (SIU) including:
  - Memory Controller and Wait State Generator via Eight(8) General Purpose Chip-Select Machines (GPCM) and two(2) Universal Programmable Machines (UPM)
  - Development Port/Background Debug Monitor
  - System Configuration and Protections such as the Bus Monitor, Software Watchdog Timer, and Periodic Interrupt Timer
  - PLL Clock synthesizer
- Communication Processor Module (CPM) including:
  - One (1) Fast Ethernet Channel (Media Independent Interface)
  - Four SCCs, all of which can do IEEE 802.3 Ethernet
  - Two SMCs (UARTs)
  - One SPI Interface
  - One I2C Interface
  - Seven IRQ lines
  - I/O port pin banks, some of which can be programmed to generate an interrupt when a condition is present

A Development Port, commonly referred to as a Background Debug Monitor (BDM) debug port on other processors, is resident in the MPC860 to assist in debugging and troubleshooting the processor operation.

NOTE

The MPC860 is +5V I/O tolerant on all of its pins except for the clock input. This is important because the signals from the TRAM-NET Hub are +5V signal levels.

Memory subsystem

The processor PCB provides the memory resources necessary for code storage and execution, and nonvolatile and configuration data storage by providing the following:

- FLASH Memory for Boot Code, Main Code and Parametric (TMSS) Storage Memory,
- DRAM Memory for Code Execution and Volatile Data Storage, and,
- SRAM Memory that is battery backed for Nonvolatile Data Storage.
- EEPROM Memory for network configuration data.

The memory subsystem utilizes the memory controller facility of the MPC860. This allows for the addresses, strobe generation and wait stating to be under software control.

Peripheral set

Clock Source – The central clock source for the processor PCB is a crystal oscillator with a frequency of 14.7456 MHz.

Power monitor, watchdog and battery switch – The MAX793 provides the following facilities:

- Power-on reset
- Battery switchover
- Battery charge level indication (battery OK)
- Power going away indication (Low Line)
- SRAM chip select gating
- Manual reset input
- Watchdog facility

Real time clock – The Epson RTC-8593AA is the Real Time Clock (RTC) used. It is an I2C RTC with an internal crystal and can operate with a supply voltage of +3.3V. The storage of the year will have to be done in another location since this RTC has only 2 bits for storage of the year. The RTC must be battery backed to insure that the time is continued to be kept during power down periods. The I2C address for the RTC is “1011xxxx”.

Serial EEPROM – The serial EEPROM used is a Xicor X24165. The X24165 is a 16k bit part organized as 2k x 8, I2C compatible and a +3.3V part. The data stored in the EEPROM would be the Ethernet Address, IP Address, Software level, product type, year and Power-Applied Indication. The I2C address for the EEPROM is “1010001x”.

NOTE

The serial EEPROM on the Solar 8000M/i processor PCB is not removable.

Audio tone generation and output amplifier – The Solar 8000M/i processor PCB provides audio output for alarm and parameter tones.

FPGA logic chip – The Processor PCB has one (1) Field Programmable Gate Array logic chip on the board to provide the PCI host bridge interface, the TRAM-NET strobe processing, the M-port support and a revision port. The FPGA used is an Altera 6016 FLEX FPGA. The FPGA is configured at power up by the Boot Code startup software loading the FPGA configuring data into the FPGA. Therefore the FPGA does not contain any functionality that is needed to allow the MPC860 to access and execute Boot Code or any other necessary facilities needed to get the processor PCB initialized at startup. In addition, any signal lines that the FPGA drives must be able to accommodate the fact that at power up the FPGA lines are high impedance until the FPGA is programmed.

NOTE

The FPGA must be 5V I/O tolerant since it is interfacing the older +5V technology parts such as the TRAM-NET Hub.

Video system

The video system consists of one video accelerator and two duplicate sets of CRT and flat panel buffers. A maximum of two analog and two digital flat panel displays can be used.

A 65.00 MHz clock oscillator is used to drive the video system. The MPC860 accesses the video systems over the PCI Bus using the Host Bridge implementation within the FPGA.

Video system components

The video system has a video graphics chip, some discretes and connectors for VGA (RGB) and DFP (Digital Flat Panel) video displays as well as a RS-232 serial port to provide for a Touchscreen input.

Video graphics chip – The video graphics accelerator chip has the following facilities:

- 4 Mbytes of internal memory
- A bandwidth of 800 Mbytes/second minimum
- RAMDAC for direct VGA/RGB output
- Flat Panel Drive (using SiI164 components)
- Programmable Ports Pins

VGA video output – The RGB output from the graphics accelerator is used to generate the video signals output on the 15 pin VGA video connectors.

DFP video output – Flat Panel drive signals from the video accelerator are interfaced to a Silicon Image SiI164's.The SiI164's convert signals to transition Minimized Differential Signaling (TMDS) levels before connection to the 20 pin MDR DFP connectors.

RS-232 serial ports

The **RS-232** serial ports provide the interface to the iPanel computer (**RS-232 1**) and serial communication devices such as a touchscreen display. See the Communication System for detailed discussion.

PCI bus implementation

The PCI Bus is used to communicate with the video accelerator and two (2) expansion slots. The PCI Bus is a 32 bit, 33MHz implementation. The PCI Bus interface to the MPC860 Bus was accomplished by implementing a purchased Intellectual Property (IP) design in the FPGA for a Host Bridge and PCI Bus Arbiter.

Communication system

Ethernet for unity

The Processor PCB provides one (1) IEEE 802.3 10BaseT compliant Ethernet port. This port is implemented using an SCC within the MPC860 and an LXT905 Serial Interface Adapter. An Ethernet Port Address label is affixed to the connector bracket and visible to the user without disassembly.

Processor SCC channel – The first Serial Communication Controller (SCC) is used to implement the Ethernet channel.

Serial interface adapter – The LXT905 is used as the Serial Interface Adapter (SIA) for each Ethernet channel.

TRAM-NET (2 ports)

The Processor PCB provides an interface to the GEHC proprietary Carrier Sense Multiple Access/Collision Detection (CSMA/CD) network, TRAM-NET, by providing a TRAM-NET Controller (TNC) and a Hub facility. The **TRAM-NET 1** port provides TRAM-NET communication only for connection to the Tram-rac 4A or Tram-rac 2. The **TRAM-NET 2/ePort** port provides TRAM-NET communication or ePort communication for connection to the PDM with an ePort cable. When the **TRAM-NET 2/ePort** connector is connected to PDM, the connection uses ethernet through the Broadcom ethernet switch.

Processor SCC channel – The MPC860 fourth Serial Communication Controller (SCC) is used to implement the TRAM-NET Controller. This is done by operating the SCC in transparent mode and using software to provide the functionality that was originally provided by an external communications processor.

Hub – The Hub chip is the Solar 9000 FPGA implementation. It accommodates the TNC port as well as four (4) external ports functioning as a “Header Hub”. The Header Hub “turns the signal around” by sending the “Up” signal out on the “down” path, generates the carrier sense signal so that the TNC will not cause an “out of window” collision, generates Collision Presence signals at the detection of a collision, and retimes the bits.

NOTE

The signals out of the Hub are at +5V signal levels, so any +3.3V devices interfacing to the Hub must be +5V tolerant.

Drivers and receivers – The DS8923 Dual Differential Driver/Receiver pair is used to convert the signals between the TRAM-NET differential RS-422 level and TTL levels.

Isolation – The TRAM-NET signals are electrically isolated with signal transformers. The TRAM-NET power source is not isolated before being delivered to the TRAM-NET network.

ESD protection scheme – The typical diode/transzorb pair is employed to clamp the TRAM-NET connector pins to the common return plane. Since the TRAM-NET is really not an electrically isolated network, the need for maintaining isolation in the ESD protection scheme is not present.

M-Ports (4)

ID signal – The ID Signal is generated using a Dallas Semiconductor 1-Wire Line Driver chip, DS2480. The DS2480 is interfaced by the MPC860's SCC3, which is multiplexed in the FPGA across the four (4) M-Ports. The benefit of the DS2480 is that it relieves the MPC860 of doing most of the timing for the interface to the 1-Wire memory device, such as the DS2430 out in the DIDCA device. Also it improves noise immunity by reading at the latest possible time and it minimizes emissions by driving the line with a controlled edge rate and controlled drive current. The rate at which the DS2480 can receive new commands or transfer additional bytes of data is synchronized by the MPC860 waiting for a received character interrupt response from the DS2480 before it can load the next character. The ID signal has its own Return line. The ID Signal and its Return share the RJ-45 connector pins that the M-Port Ethernet 10 Base T Transmit differential pair uses. The functionality of the shared connector pins is determined by a relay under software control.

RS-232/UART interface – The M-Port RS-232 interface is provided by a Philips SC28L194 Quad UART (one UART per M-Port) and an Analog Devices ADM202E RS-232 Driver/Receiver. The SC28L194 Quad UART has sixteen (16) byte FIFO's on both the receiver and transmitter and I/O port pins that function as status LED drive signals. The benefit of the FIFOing is to reduce the overhead to the MPC860 to service the UART's. The Quad UART uses the auto vectored interrupt on level 3.

Ethernet facility – A Broadcom Ethernet Switch provides each M-Port with Ethernet capability. With the relay in the Ethernet position, pins 3 and 6 in the RJ-45 connector provide the Ethernet Differential Transmit pair. The Ethernet receive pair are provided on pins 1 and 2 of the RJ-45 connector.

NOTE

The M-Port provides Host or Hub pinouts, not device side pin outs, so that a one-to-one Category 5 cable can be used to connect any Ethernet device up using an M-Port.

The Serial Management Interface (SMI) to the Broadcom Ethernet Switch is provided by reprogramming SCC3 in the MPC860 to be an HDLC controller and setting the appropriate MPC860 port pins to get the proper muxing action within the FPGA. The use of the SMI is to determine which M-Ports have a functioning 10BaseT Ethernet connection on them without having to switch the relay back to ID mode and interrogate for a One-Wire interface.

NOTE

The clock source for the SMI is selected by the MPC860 to be either sourced by itself or by the Broadcom Ethernet Switch under software control.

M-Port power sourcing – Each **M-Port** is capable of providing +5V +/- 5% @ 100mA into an external load.

Isolation – Per the M-Port Specification, Basic Insulation for 250Vac is provided between each M-Port and any other isolated facility and from earth ground.

ESD protection scheme – The **M-Port** connectors are ESD protected by using the planar capacitance method since they are isolated from an earth connection. The typical diode/transzorb pair is employed to clamp the connector pin to its isolated return plane. The impedance of the connector contact, the ferrite bead and the copper traces form an impedance divider with the 'planar' capacitor formed by the dielectric material in the PCB layer between the copper of the isolated return plane and the copper of the common (earthed) plane. The expectation is that the physical impedance divider formed by the bead/trace/connector inductance and the planar capacitor will accomplish the following two results:

- Limit the rate of rise of the voltage across the isolation barrier, i.e., across the planar capacitor, and
- Limit the peak amplitude to which the voltage across the barrier rises to.

RS-232 serial ports

Both RS-232 serial ports are associated to a video set as described earlier to accommodate a touchscreen. However, the serial ports are not limited to being a touchscreen interface only. The **RS-232 1** port also interfaces to the iPanel computer and either of these serial ports are capable of providing a polled data service facility or can be used as a service port.

Processor SMC channels – The **RS-232 1** uses the SMC1 and the **RS-232 2** will use SMC2 in the MPC860.

Isolation – The serial ports are not isolated with respect to earth ground.

ESD protection scheme – The typical diode/transzorb pair is employed to clamp the RS-232 serial port connector pins to the common return plane. Since the serial ports are not electrically isolated, the need for maintaining isolation in the ESD protection scheme is not present.

I^2C bus

The I^2C bus is used to interface to the Real Time Clock and the Serial EEPROM.

SPI interface

The SPI is used to program the FPGA.

Power supply

The power supply generates DC voltages necessary to power the processor board and the communication channels (**M-port**s and devices connected to TRAM-NET). It consists of a mains (AC line) PWM converter, that creates a 16.75 output voltage bus from which two outputs are developed. The main 16.75V output also provides external power to the RAC, data acquisition modules, and plug-in modules.

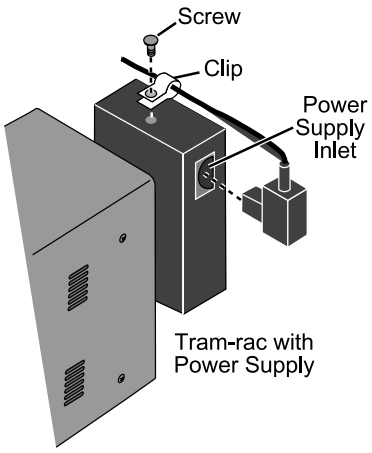
Speaker

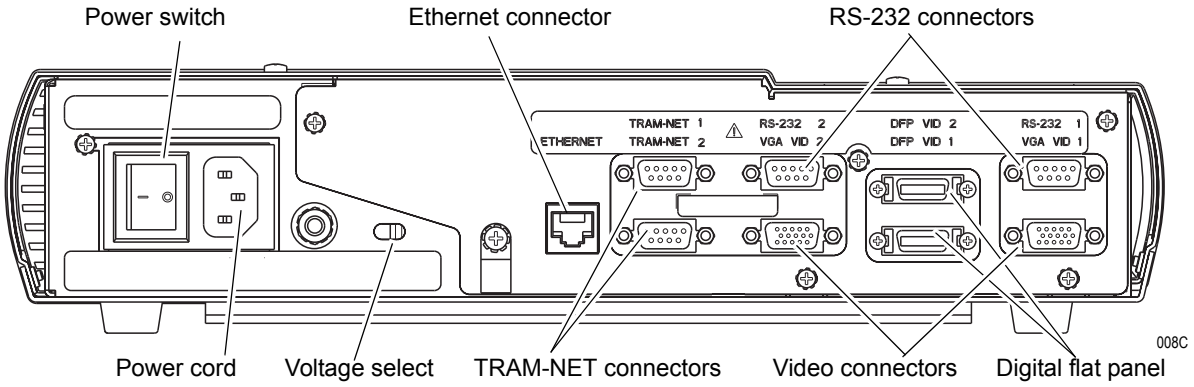
The speaker generates sound for alarms, QRS detection, and SpO_2 pulse tones.

3 Installation

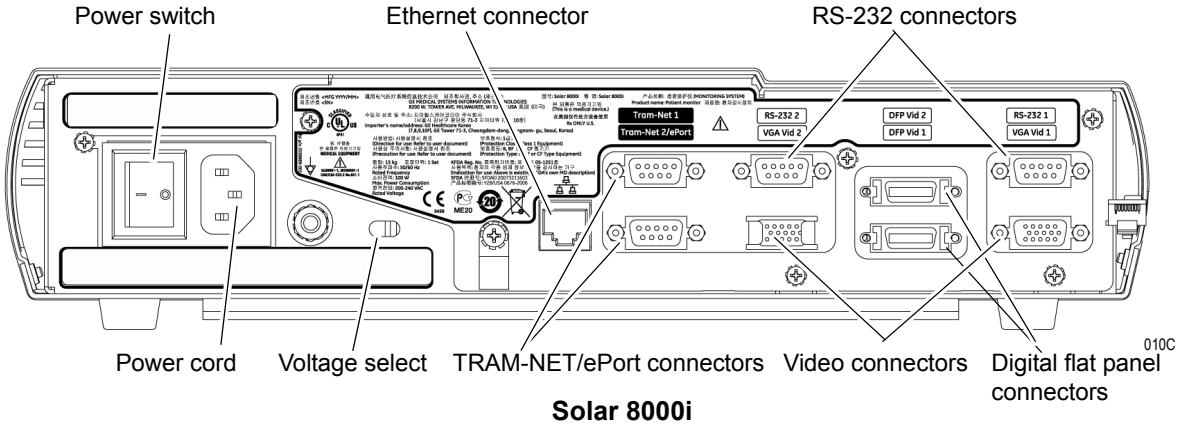
Back panel connections

Connect the power cord to the power supply inlet on the back of the Solar 8000M/i patient monitor. If using a Tram-rac with power supply, connect the power cord as shown.





Solar 8000M



Solar 8000i

NOTE

The number of video connectors varies by configuration.

CAUTION
Equipment damage. Connect all peripheral equipment before plugging the power cord into an AC outlet. Otherwise, connectors may be damaged.

TRAM-NET

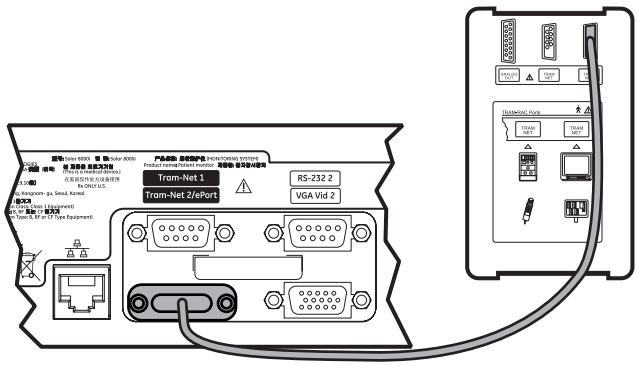
TRAM-NET provides the network for communication with bedside peripherals and acquisition modules.

NOTE
If two Tram-racs are connected in any configuration, one must have a power supply.

The following devices connect to either of the two **TRAM-NET** ports on the Solar 8000M/i monitor. The connector is a 9-pin, D-type.

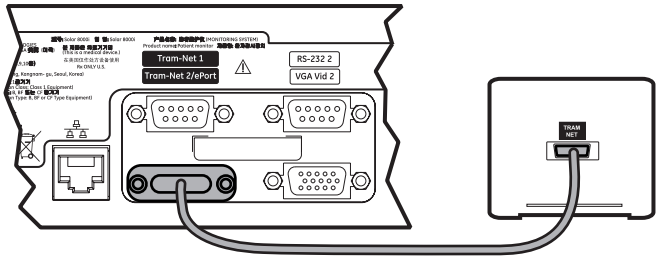
- Tram-rac 4a housing with or without power supply
- Tram-rac 2 housing
- Tram-rac 4 housing with or without power supply
- Tram-rac 3 housing with or without power supply
- Patient Data Module (PDM) connects to **TRAM-NET 2/ePort** connector only.

Tram-rac 4a housing



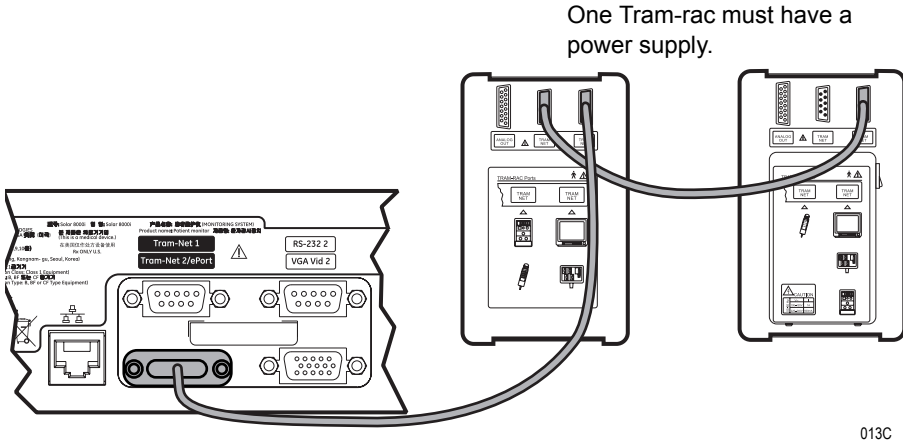
009C

Tram-rac 2 housing



011A

Tram-rac 4a housings with and without power supply

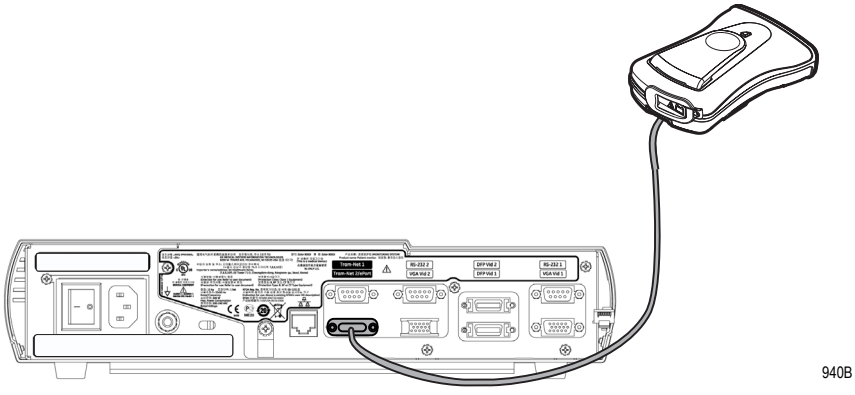


CAUTION

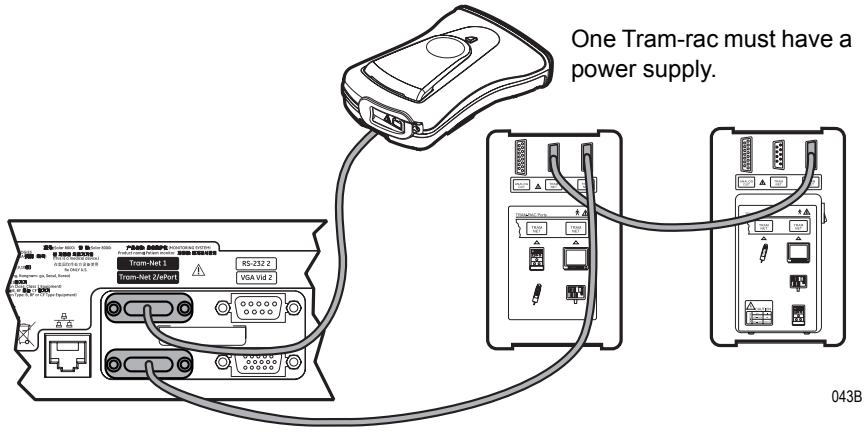
Equipment damage. Connect the Tram-rac housing to the Solar 8000M/i patient monitor *before* plugging the power cord into an AC outlet. Connecting these devices to a powered Solar 8000M/i patient monitor could damage connectors.

Patient Data Module

The Patient Data Module (PDM) is an acquisition device that connects to the Solar 8000i patient monitor via the ePort cable.



Connect one end of the ePort cable to the **TRAM-NET2/ePort** connector and the other end to the Patient Data Module.



ETHERNET

The **ETHERNET** connector provides an ANSI/IEEE 802.3 10BaseT Ethernet standard interface to the Unity Network using a Category 5 network cable. The connector is an 8-pin, RJ-45 type.

VGA VID 1 and 2

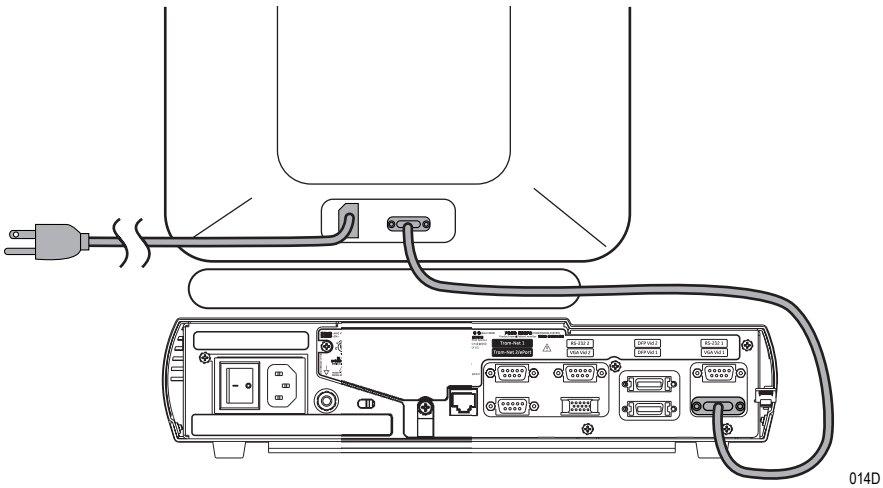
NOTE

The number of video connectors varies by configuration.

The two VGA connectors provide an interface to analog (VGA) displays. The connector is a 15-pin, high density D type.

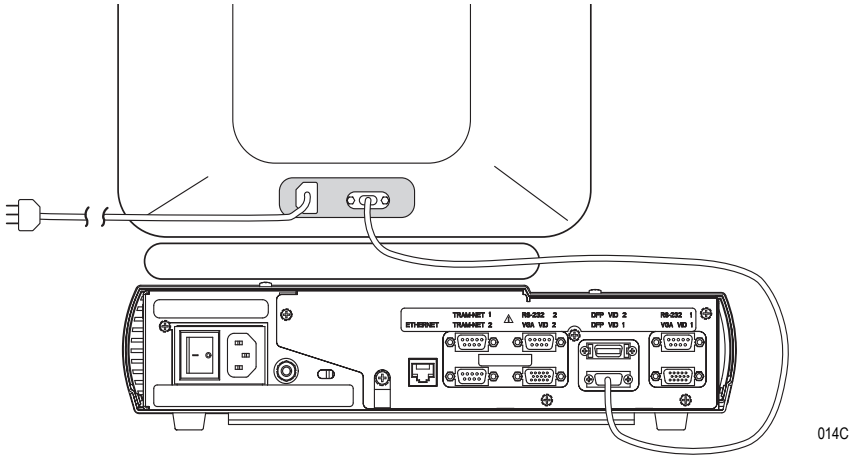
WARNING

Do not connect a monochrome display to the Solar 8000M/i patient monitor. Visual alarm indictors may not appear properly, resulting in a hazard to the patient.



DFP VID 1 and 2

Two DFP (Digital Flat Panel) connectors provide an interface to digital displays. The connector is a 20-pin, MDR type.



RS-232 1

The **RS-232 1** serial connector provides an interface to the iPanel computer. If not using an iPanel, it interfaces to a PC for software upgrades or polled-parameter service. The connector is a 9-pin, D type.

RS-232 2

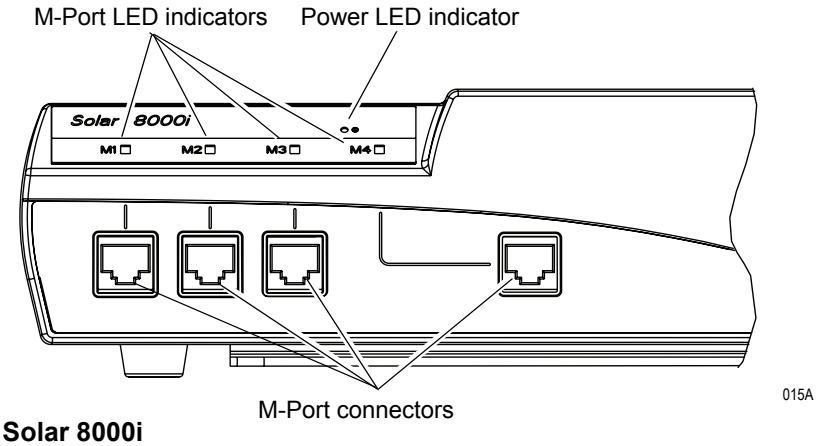
The **RS-232 2** serial connector provides a touchscreen interface. The connector is a 9-pin, D type.

NOTE

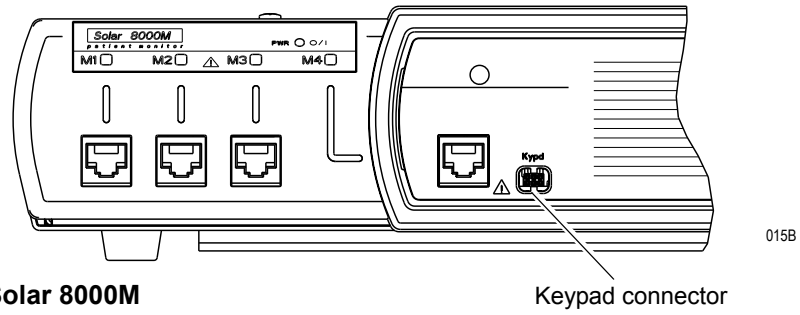
Use cable 2006733-00X for touchscreen connection. The cable supplied with the display will not work.

Front panel connectors and indicators

The front panel connectors consist of four M-Ports. The Solar 8000M also has a keypad connector. Each port has a LED indicator.



Solar 8000i



Solar 8000M

M-Ports

M-Port means multi-protocol and supports Ethernet 10BaseT, RS-232, 1 wire identification, and is MIB (Medical Information Bus) compliant. M-Ports support AutoPort devices, but an AutoPort to M-Port adapter, PN 2001973-001, is required. The adapter must connect to the AutoPort device, not the M-Port host (the Solar 8000M/i patient monitor).

The following devices connect directly to the M-Ports. The connector is an 8-pin RJ-45 type.

- Solar 8000M/i remote control
- Solar 8000M/i keypad
- PRN 50-M digital writer
- RM-M respiratory mechanics module
- Remote Alarm Terminal (Nurse Call and Alarm Light System)
- Laser printer (requires a serial port on the printer and an interface adapter to connect to the monitor)
- Unity Network ID connectivity device

The following devices connect to M-Port hosts using AutoPort to M-Port adapter PN 2001973-001.

- PRN-50 digital writer with AutoPort
- Respiratory mechanics module with AutoPort

NOTE

AutoPort to M-Port adapter PN 2001973-001 is required for connecting AutoPort devices to M-Ports. Plug the adapter end labeled **AutoPort** into the AutoPort device.

Remote control or keypad

The remote control or keypad is DIDCA programmed for specific care areas (adult, neonatal, or operating room). A keypad holster mount is available for mounting under the display.

NOTE

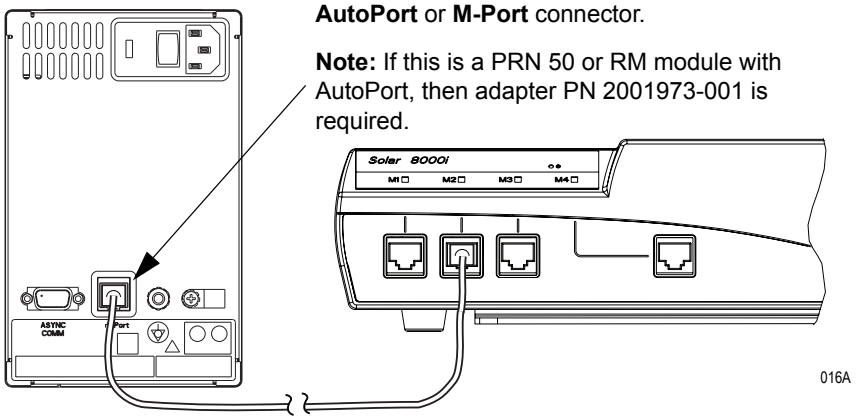
The Solar 8000M/i requires an interface (remote control or keypad) with all display types.

NOTE

The error message ***WARNING: REMOTE MISMATCHED WITH MONITORING MODE*** displays if a mismatched keypad/remote control is connected to the Solar 8000M/i patient monitor.

PRN-50 digital writer and respiratory mechanics module

The figure below shows the PRN-50-M digital writer connected to one of the M-Ports. The RM-M respiratory mechanics module has similar connections.

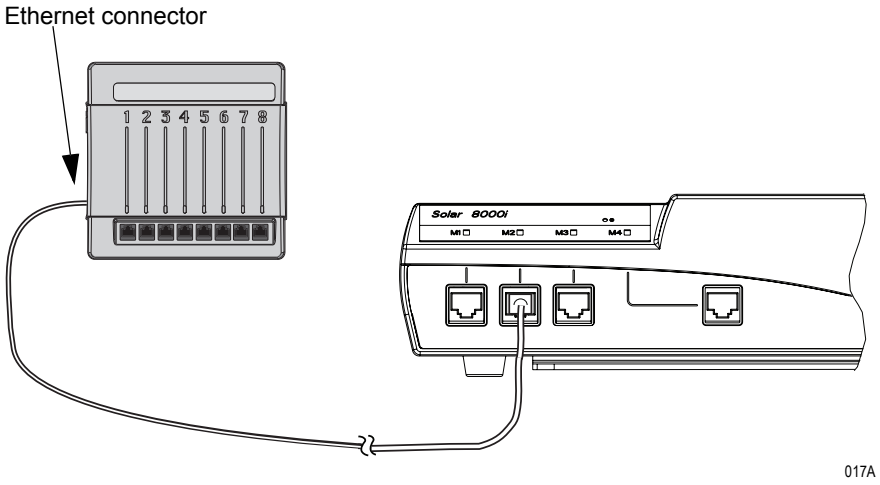


Unity Network ID connectivity device

The figure below shows the Unity Network ID connectivity device connected to one of the M-Ports.

NOTE

This connection requires that the Unity Network ID connectivity device IP address is a ***10.X.X.X*** address. Refer to the Unity Network ID connectivity device service manual for more details.



Laser printer

Refer to the instructions provided in Laser Printer Support Kit, pn 2013421-001, for details on interconnection using the interface adapter and installing a serial card in a laser printer.

WARNING

SHOCK HAZARD. Laser printers are UL 60950/EN 60950 certified equipment, which may not meet the leakage current requirements of patient care equipment. This equipment must not be located in the patient vicinity unless the medical system standard EN 60601-1-1 is followed.

Do not connect a laser printer to a multiple portable socket outlet (MPSO) supplying patient care equipment. The use of an MPSO for a system will result in an enclosure leakage current equal to the sum of all the individual earth leakage currents of the system if there is an interruption of the MPSO protective earth conductor.

Indicators

A green LED indicates that the unit is connected to an AC power source and the power switch is turned on. There is a green/yellow LED above each M-Port indicating the M-Port status.

- Solid green indicates the device is communicating properly.
- Slow flashing yellow indicates the device has been identified, but there is no communication.
- Quick flashing yellow indicates that too many identical devices are connected or the device cannot be identified.

Refer to Chapter 5, "Troubleshooting" if an LED is not green.

Power up

NOTE

Check power voltage at your location and set power to either 120 V or 240V.

After making all connections, plug the power cord into an AC wall outlet, turn the power switch to **1** (on), and turn on the display. The power LED illuminates and after about 10 seconds a display appears.

If the Solar 8000M/i patient monitor does not work properly, refer to Chapter 5, "Troubleshooting" .

TRAM-NET communication

Overview

The Solar patient monitor uses two distinct local area networks:

- TRAM-NET communication, and
- Ethernet communication.

Consider TRAM-NET as a small area network (SAN) contained in one room or at the patient bedside. Consider Ethernet as the local area network (LAN) for room-to-room communication or communication between patient monitors, central stations, and other GE equipment throughout the hospital.

NOTE

GE highly recommends using a 'private' LAN to connect Unity products. The purpose of the Unity Network is to connect only Unity devices for the exchange of patient data and room-to-room communication. Adding non-Unity devices (PCs, laptops, desktops, etc.) may compromise the ability of the Unity Network to meet its intended use.

A 'private' LAN is not the same as a private IP address.

This local area network links all patient monitors, central stations, and other GE equipment throughout the hospital.

The **TRAM-NET** connector makes a TRAM-NET small area network available for the peripheral devices. The TRAM-NET controller resides within the main processor which provides efficient data transfer by sharing main memory.

Internal hub

TRAM-NET is a small network that offers ample flexibility, a high rate of communication, and relatively inexpensive cabling. Data is transmitted at the rate of 921.6K bits per second. It uses a star topology, sometimes referred to as a rooted tree topology. This means that the wiring of the network can be pictured as a star or a series of stars. The center of each star is called a hub, and the points of the star are called nodes. There are cables between the nodes and the hubs, but no cables exist between nodes.

Data is acquired at a node, and is transmitted through a hub to all the other nodes. Each node has an address so data will be received by the node with the correct destination address. It is impossible for a node to communicate with another node without the data going through a hub somewhere along its journey. The hub controls all of the data 'traffic' in the system.

In a TRAM-NET system, the head hub is contained in the patient monitor, but there will be intermediate hubs in the Tram-rac housing and Tram module as well.

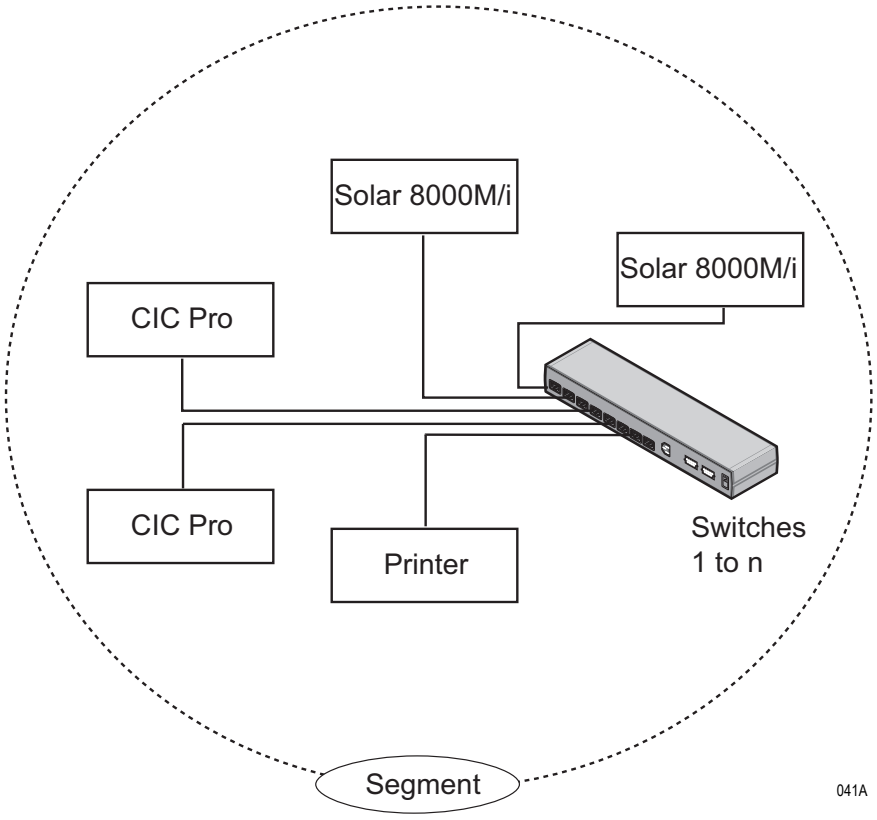
Ethernet communication

About ethernet

The GE Unity Network uses Ethernet for device-to-device communications. This local area network links all patient monitors, clinical information centers, and other GE equipment throughout the hospital. Depending on the construction of the hospital, thick-net, thin-net, or CAT-5 twisted pair cabling is used. The Solar 8000M/i is designed to be used with twisted-pair cabling. Consult GE when trying to interface with either thick-net or thin-net cabling. The real-time GE Unity Network operates at 10 Mbps, half-duplex.

Twisted pair

Twisted pair is the most popular cabling because it is easy to install and flexible to work with. It uses the star topology with a switch as the hub of the segment. A maximum of 100 meters or 328 feet is the longest length of twisted pair cable allowed. The maximum number of devices on the GE Unity Network is 1,000.



Network terms

Node

Each network device or node is assigned a MAC address number and requires a network connection to interface between the network device and the network.

MAC address

A 48-bit address assigned by the manufacturer to uniquely identify a node of the network. This is also known as the Ethernet address.

Switch

To implement the star topology, each network device is connected to a network switch. The switch passes all network data between each network device in the star segment. Typically, the switch supports 12 to 48 network devices and may be linked to other switches to form larger networks.

Segment

A network segment is comprised of all devices connected to 1 or many switches which are in-turn connected together to form a larger network. The boundaries of the segment are defined by networking equipment that regulate the flow of packets into and out of the segment (e.g. routers and switches).

IP address

A 32-bit (IPv4) address assigned by the user (either statically or dynamically from a server) to uniquely identify the packets from a device for routing purposes.

Subnet

A subnet is a logical segment of a larger network that shares a common IP address range as defined by a subnet mask. Proper subnetting can improve the performance and security of a network. Solar 8000 series monitors support classful subnetting.

4 Maintenance and checkout

Maintenance schedule

Manufacturer recommendations

To help ensure the equipment remains in proper operational and functional order, adhere to a good maintenance schedule. The manufacturer recommends that the following be performed by service personnel upon receipt of the equipment, every 12 months thereafter, and each time the unit is serviced:

- Visual Inspection
- Cleaning
- Electrical Safety Tests
- Checkout Procedure
- Clearing the Stored Patient Data Memory: Admit and discharge a test patient every 12 months to clear the monitor's stored patient data memory.

Manufacturer responsibility

WARNING
Failure on the part of all responsible individuals, hospitals or institutions, employing the use of this device, to implement the recommended maintenance schedule may cause equipment failure and possible health hazards. The manufacturer does not, in any manner, assume the responsibility for performing the recommended maintenance schedule, unless an Equipment Maintenance Agreement exists. The sole responsibility rests with the individuals, hospitals, or institutions utilizing the device.

Preventive maintenance

The message ***"EC1"*** will appear on the monitor to the left of the ECG parameter block after 395 days of operation. This message is a reminder that it is time to perform preventive maintenance procedures on the monitor. Perform all of the maintenance procedures listed under "Manufacturer Recommendations" above.

Visual inspection

The Solar 8000M/i patient monitor and its components should be carefully inspected prior to installation, once every 12 months thereafter, and each time the equipment is serviced.

- Carefully inspect the equipment for physical damage to the case, the display screen, and the keypad. Do not use the monitor if damage is determined. Refer damaged equipment to qualified service personnel.
- Inspect all external connections for loose connectors or frayed cables. Have any damaged connectors or cables replaced by qualified service personnel.
- Inspect the display face for marks, scratches, or other damage. Physical damage to a CRT display face may pose an implosion hazard. Have the CRT replaced by qualified service personnel if necessary.

Cleaning

Cleaning precautions

NOTE

See "Cleaning, disinfecting and storing GE ECG cables and leadwires" on page 4-5 for instructions specific to GE ECG cables and leadwires.

Use one of the following approved solutions:

- Cidex solution
- Sodium hypochlorite bleach (diluted)
- Mild soap (diluted)
- Lint-free cloth
- Dust remover (compressed air)

To avoid damage to the equipment surfaces, *never* use the following cleaning agents:

- organic solvents,
- ammonia based solutions,
- acetone solution,
- alcohol based cleaning agents,
- Betadine solution,
- a wax containing a cleaning substance, or
- abrasive cleaning agents.

Exterior cleaning

Clean the exterior surfaces with a clean, lint-free cloth and one of the cleaning solutions listed in the table above.

- Wring the excess solution from the cloth. Do not drip any liquid into open vents, switches, plugs, or connectors.
- Dry the surfaces with a clean cloth or paper towel.

Cleaning the display

To clean the display, follow the recommendations of the display's manufacturer. In general you will need to use a soft, clean, lint-free cloth dampened with a glass cleaner.

CAUTION

To avoid getting liquid into connector openings, do not spray glass cleaning or general cleaning solutions directly onto the product's surface.

Cleaning the Touch Screen Display

1. Turn OFF the mains power switch on the monitor and disconnect it from the power source.
2. Clean the screen with an *ammonia free* glass cleaner and lint free cloth.

CAUTION
Do not spray any glass cleaning solution or any general cleaning solutions directly onto the monitor's display surface. Always dampen the towel and then clean the screen.

Cleaning, disinfecting and storing GE ECG cables and leadwires

NOTE
These instructions supersede all cleaning/disinfecting instructions for GE ECG Cables and Leadwires. All safety statements and notes in the manual still apply.

Cleaning or disinfecting

1. Remove cables and leadwires from the handheld device or system before cleaning.
2. Use care in cleaning leadwires to prevent pulling the long wires from the connector ends. Metal connections can be pulled away from the connectors.
3. For general cleaning of cables and leadwires, wipe using a lightly moistened cloth with a mild soap and water solution. Then wipe and air dry.
4. For disinfecting the cables and leadwires, wipe exterior with a soft lint-free cloth, using the following solution as recommended in the APIC Guidelines for Selection and Use of Disinfectants (1996):
   - Sodium hypochlorite (5.2% household bleach) minimum 1:500 dilution (minimum 100 ppm free chlorine) and maximum 1:10 dilution.
   - Any sodium hypochlorite wipe product that meets the above guidelines of can be used.

   NOTE
   Wring excess disinfectant from wipe before using.

   NOTE
   Any contact of disinfectant solutions with metal parts may cause corrosion.
5. Do *not* immerse either end of a cable or leadwire connector. Immersing or "soaking" the connector ends may corrode metal contact ends and affect signal quality.
6. Wipe off cleaning solutions with a clean, lightly moistened cloth.

7. Dry thoroughly with a dry lint-free cloth and let air dry for at least 30 minutes.

   NOTE
   Drying times may vary based on the environmental conditions.

8. Take care not to let fluid "pool" around connection pins. If this should happen, blot dry with a soft, lint-free cloth.
9. *Do not* use excessive drying techniques, such as oven, forced heat or sun drying.

Sterilization

NOTE
EtO sterilization is *not recommended*, but may be required for cables and leadwires. Frequent sterilization will reduce the useful life of cables and leadwires.

Sterilize with ethylene oxide gas (EtO) at a maximum temperature of 50° C/122° F. After EtO sterilization, follow the recommendations from the sterilizer manufacturer for required aeration.

Cautions

- Never immerse the handheld device, cables, or leadwires in any liquid.
- Do not pour or spray any liquid directly on cables or leadwires or permit fluid to seep into connections or openings.
- Never use conductive solutions, solutions that contain chlorides, wax, or wax compounds to clean handheld devices, cables or leadwires.
- Never use solutions or products that contain the following:
  - Any type of Ammonium Chloride such as, but not limited to:
    - Dimethyl Benzyl Ammonium Chloride
    - Quaternary Ammonium Chloride solutions
  - Abrasive cleaners or solvents of any kind
  - Acetone
  - Ketone
  - Betadine
  - Alcohol-based cleaning agents
  - Sodium salts
- Never autoclave or steam clean cables or leadwires.

Storage

- Store in a dry well-ventilated area.
- Vertically hang cables and leadwires.
- Do not coil leadwires or cables tightly around any medical device.

Improper cleaning products and processes impact/results

- Product discoloration.
- Metal part corrosion.
- Brittle wires.
- Brittle and breaking connectors.
- Reduced cables and leadwires life.
- Unit malfunction.
- Void warranty.

Cleaning products to avoid

Cleaning products known to cause the types of problems listed above include, but are not limited to:

- Sani-Cloth® Wipes
- Ascepti® Wipes
- HB Quat
- Clorox® Wipes (they do not contain bleach).
- Over-the-counter detergents (e.g. Fantastic®, Tilex®, etc.).

Products that contain active ingredients and solutions similar to these products should also be avoided.

NOTE

For additional information, refer to the How to Reach Us page of the manual for contact information. Also see the GE Handheld Medical Devices Cleaning, Disinfecting, and Storage addendum.

Electrical safety tests

Recommendations

Electrical safety tests provide a method of determining if potential electrical health hazards to the patient or operator of the device exist.

GE recommends that all safety tests be performed

- upon receipt of the device,
- once a year thereafter,
- after any upgrade,
- any time the main enclosure is disassembled, or a part is repaired or replaced.

Record the date and results on the Repair Log included at the end of this chapter.

These instructions are intended for every component in the system. If the system includes a Tram-rac housing without its own power supply, it should remain connected to the monitor throughout the safety tests.

WARNING
Failure to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards. Unless you have an Equipment Maintenance Contract, GE does not in any manner assume the responsibility for performing the recommended maintenance procedures. The sole responsibility rests with the individual or institution using the equipment. GE service personnel may, at their discretion, follow the procedures provided in this manual as a guide during visits to the equipment site.

Test conditions

Perform electrical safety tests under normal ambient conditions of temperature, humidity, and pressure.

Test equipment

The recommended test equipment required to perform electrical safety tests is listed below.

Item	Specification
Leakage Current Tester	Equivalent to the circuits shown
Digital Multimeter (DMM)	AC volts, ohms
Ground Bond Tester	0 – 1 ohm
ECG Test Body	All leads together
Masimo SET SpO2 Test Body	2006036-001
Host patient monitor system	Solar 8000M or Solar 8000i
Acquisition device	Tram-rac with TRAM module or Patient Data Module

Set up

Prepare the Solar 8000M or Solar 8000i patient monitor and the acquisition device for electrical safety tests.

1. Confirm that all components of the monitoring system are correctly connected as described in Chapter 3, "Installation" .
2. Verify that the power indicator illuminates on the acquisition device.

Power outlet test

Verify that the power outlet is wired correctly per the country's electrical code standard before starting the following electrical safety tests. The results of the following tests will be inaccurate unless a properly wired power outlet is used.

Ground (earth) integrity

Listed below are two methods for checking the ground (earth) integrity, "Ground Continuity Test" and "Impedance of Protective Earth Connection." These tests determine whether the device's exposed metal and power inlet's earth (ground) connection have a power ground fault condition.

Perform the test method below that is required by your country/local governing safety organization.

Ground continuity test

1. Disconnect the device under test from the power outlet.
2. Connect the negative (–) lead of the DMM to the protective earth terminal (ground pin in power inlet connector) or the protective earth pin in the mains plug (ground pin in power cord).
3. Set the DMM to the milliohm (mΩ) range.
4. Connect the positive (+) lead of the DMM to all exposed metal surfaces on the device under test.
5. Resistance must read:
   - 0.1 ohm or less without power cord
   - 0.2 ohms or less with power cord

Impedance of protective earth connection

This test stresses the ground system by using special ground bond testers and is normally only required as a manufacturing production test to receive safety agency compliance.

Some country agencies do require this test after field equipment repairs (i.e. Germany's DIN VDE 0751 standards). Consult your country/local safety agency if in question.

Check compliance as follows:

1. A current of 25A from a current source with a frequency of 50 or 60 Hz with a no-load voltage not exceeding 6 V is passed for at least 5 seconds through the protective earth terminal or the protective earth pin in the mains plug and the equipotential stud which could become live in case of failure in basic insulation.
2. The voltage drop between the parts described is measured and the impedance determined from the current and voltage drop. It shall not exceed the values indicated.

   When taking this measurement, move the unit's power cord around. There should be no fluctuations in resistance.

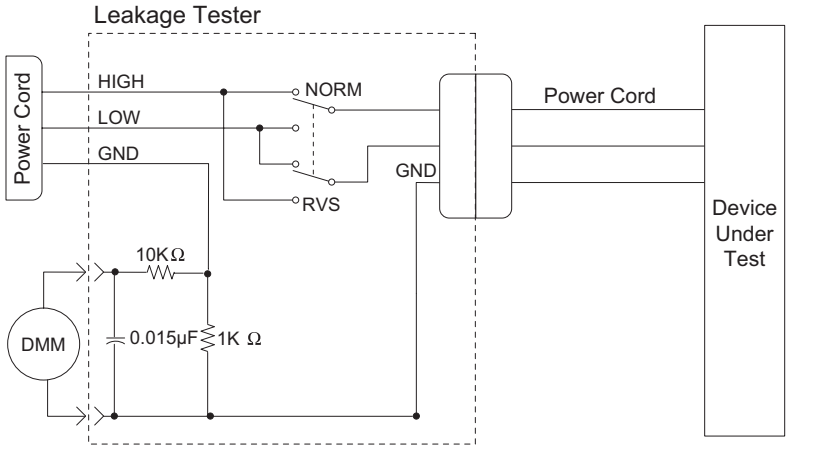
   - For equipment without a power supply cord the impedance between the protective earth terminal and the ground tabs of the Video In connector which is protectively earthed shall not exceed 0.1 ohms.
   - For equipment with a power supply cord the impedance between the protective earth pin in the mains plug and the ground tabs of the Video In connector which is protectively earthed shall not exceed 0.2 ohms.

Ground (earth) wire leakage current tests

Perform this test to measure current leakage through the ground (earth) wire of the equipment during normal operation.

The device under test is to be tested at its normal operating voltage.

1. Configure the leakage tester like the circuit shown below.



DMM set to measure AC voltage

2. Connect the power cord of the device under test to the power receptacle on the leakage tester.
3. Set the power switch of the device under test to ON.
4. Read the current leakage indicated on DMM.
5. Set the polarity switch on the leakage tester to RVS (reverse).
6. Read the current leakage indicated on DMM.

NOTE

If either reading is greater than the appropriate specification below, the device under test fails. Contact GE Technical Support.

- 300 μA (0.3 volts on the DMM), and the device under test is powered from 100-120 V/50-60 Hz.
- 300 μA (0.3 volts on the DMM), and the device under test is powered from a centered-tapped 200-240 V/50-60 Hz, single phase circuit.
- 500 μA (0.5 volts on the DMM), and the device under test is powered from a non-center-tapped, 200-240 V/50-60 Hz, single-phase circuit.

NOTE

Center-tapped and non-center-tapped supply circuits produce different leakage currents and the UL and EN limits are different.

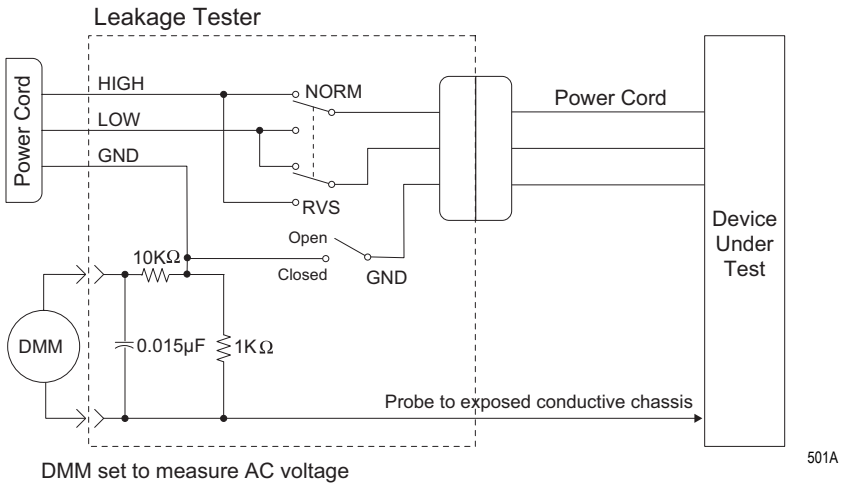
7. Set the power switch of the device under test to OFF.

Enclosure leakage current test

This test pertains to the Solar 8000M/i, part of the monitoring system.

Perform this test to measure current leakage through exposed conductive surfaces on the device under test during normal operation.

1. Configure the leakage tester like the circuit shown below with GND switch OPEN and polarity switch NORM.



DMM set to measure AC voltage

2. Connect probe to an unpainted, non-anodized chassis ground on the device under test.
3. Set the power switch of the device to ON.
4. Read the current leakage indicated on DMM.

NOTE

Center-tapped and non-center-tapped supply circuits produce different leakage currents and the UL and EN limits are different.

5. Set the polarity switch to RVS.
6. Read the current leakage indicated on DMM.

NOTE

If either reading is greater than the appropriate specification below, the device under test fails. Contact GE Technical Support.

- 300 µA (0.3 volts on the DMM), and the device under test is powered from 100-120 V/50-60 Hz.
- 300 µA (0.3 volts on the DMM), and the device under test is powered from a centered-tapped 200-240 V/50-60 Hz, single phase circuit.
- 500 µA (0.5 volts on the DMM), and the device under test is powered from a non-center-tapped, 200-240 V/50-60 Hz, single-phase circuit.

7. Set the GND switch on the leakage tester to CLOSED.
8. Read the current leakage indicated on DMM.

9. Set the polarity switch to RVS.
10. Read the current leakage indicated on DMM.

    NOTE

    If the reading is greater than the specification below, and the device under test is powered from 100-240 V/50-60 Hz, the device under test fails. Contact GE Technical Support.

    - 100 microamperes (0.1 volts on the DMM), and the device under test is powered from 100-240 V/50-60 Hz.

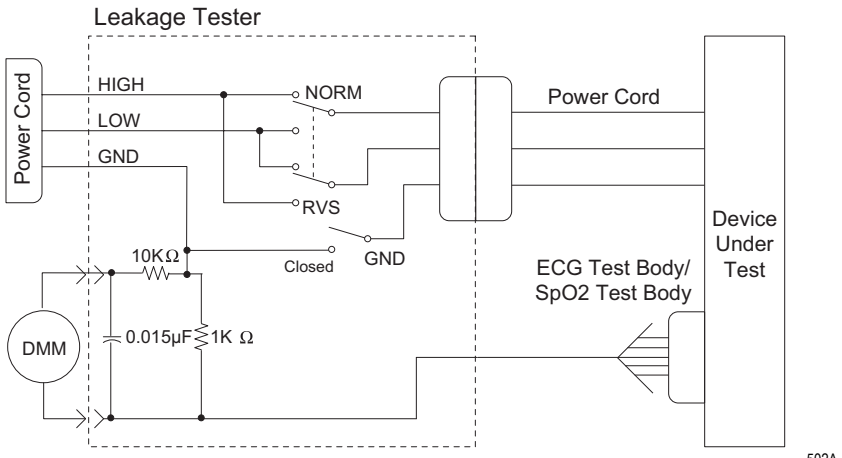
11. Set the power switch of the device under test to OFF.

Patient (source) leakage current test

This test pertains to the Solar 8000M/i, part of the monitoring system.

This procedure only applies to Class I (grounded/earthed) equipment, and measures the leakage current from the ECG/RESP connector then the SpO2 connector of the device to ground.

1. Configure the leakage tester like the circuit shown below with GND switch OPEN and polarity switch NORM.



DMM set to measure AC voltage

2. Connect an ECG test body to the ECG/RESP connector of the device under test.
3. Set the power switch of the device to ON.
4. Read the leakage current indicated on the DMM.
5. Change the leakage tester polarity switch to the RVS position.
6. Read the leakage current indicated on the DMM.

    NOTE

    If either reading is greater than 50 µA (0.05 volts on the DMM), the device fails this test. Contact GE Technical Support.

7. Change the GND switch to the closed position.
8. Read the leakage current indicated on the DMM.

9. Change the leakage current switch to the RVS position.
10. Read the leakage current indicated on the DMM.

    NOTE

    If either reading is greater than 10 µA (0.01 volts on the DMM), the device fails this test. Contact GE Technical Support.

11. Set the power switch of the device to OFF.

    NOTE

    The AAMI and EN single fault condition (ground open) is 50 µA, whereas the normal condition (ground closed) is less.

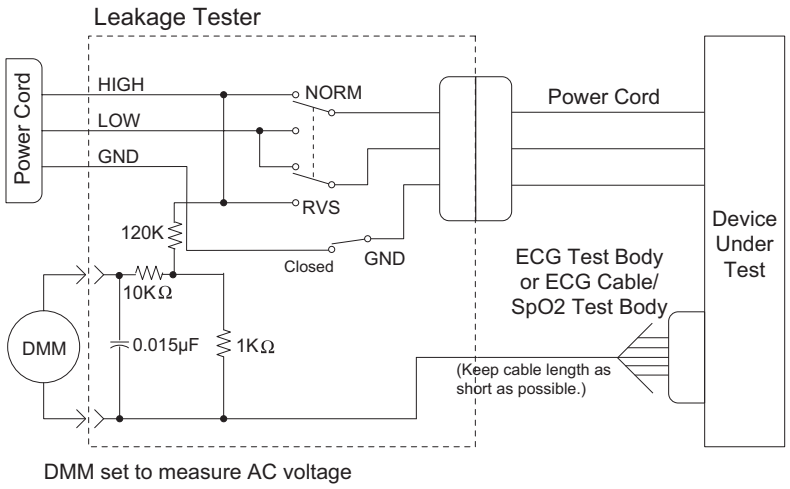
12. Repeat the steps in this procedure using the appropriate SpO2 Test Body. Connect the SpO2 Test Body to the blue SpO2 connector of the device under test.

Patient (sink) leakage current test

This test pertains to the Solar 8000M/i, part of the monitoring system.

This procedure only applies to Class I (grounded/earthed) equipment, and measures the leakage current from a mains voltage source into the ECG/RESP connector then the SpO2 connector.

1. Configure the leakage tester like the circuit shown below with GND switch CLOSED and polarity switch NORM.



WARNING

Shock hazard. The following step causes high voltage at the test body. Do not touch the test body.

2. Set power switch on the device to ON.
3. Read leakage current indicated on DMM.
4. Change the leakage tester polarity switch to the RVS position.
5. Read the leakage current indicated on the DMM.

NOTE

If either reading is greater than the appropriate specification below, the device under test fails. Contact GE Technical Support.

- 10 µA (0.01 volts on the DMM) at 120 VAC using the test body.
- 20 µA (0.02 volts on the DMM) at 240 VAC using the test body.
- 50 µA (0.05 volts on the DMM) at 120-240 VAC using the ECG cable.

NOTE

The 10 and 20 µA limits are based on internal design standards. The 50 µA limit is common to all standards. AAMI ES-1 standard requires using the patient cable.

6. Set the power switch on the device to OFF.
7. Repeat the steps in this procedure using the appropriate SpO2 Test Body. Connect the SpO2 Test Body to the blue SpO2 connector of the device under test.

Test completion

1. Disconnect the leakage tester from the power outlet.
2. Disconnect all test equipment from the device.
3. Disconnect the device power cord from the leakage tester.

Checkout procedure

General

These procedures test the functions of the patient monitor, Tram-rac housing or Patient Data Module and associated communication networks. For other input modules checkout procedures, refer to their appropriate service manual.

GE recommends that all checkout procedures be performed

- upon receipt of the device,
- once a year thereafter,
- after any upgrade,
- any time the main enclosure is disassembled, or a part is repaired or replaced.

Record the date and results on the Repair Log included at the end of this chapter.

Required tools and equipment

NOTE

Be sure test equipment is maintained according to manufacturer's maintenance schedule to ensure accuracy.

The following table lists the test equipment, adapters, and cables necessary to complete the checkout procedures. Equivalent equipment may be substituted

Acquisition device: ■ Tram 100-851 module (Any GE Tram 100-851 module) ■ Patient Data Module (Any GE Patient Data Module)
Multifunctional patient simulator (MARQ III or equivalent)
Patient cables (Multi-link ECG 12-lead patient cable and ECG leadwire set)
Tram-rac housing test: ■ Tram-rac (Any GE Tram-rac) ■ BP module (Any GE BP module) ■ Digital multimeter (AC volts, ohms)
M-Port test: ■ Port Checkout DIDCA (420915-031) ■ Cable, category 5 (418335-002) ■ AutoPort to M-Port Adapter (2001973-001)
Blood pressure test: ■ Blood pressure simulator cable (700095-001)

Temperature test: ■ 700/400 series dual temperature adapter (402015-004) ■ Temperature simulator cable for use with Marq III
Cardiac output test: ■ Cardiac output simulator II (900028-001) (no longer available for ordering) ■ Cardiac output cable adapter (700092-001)
Sp02 test: ■ Masimo SpO2 Test Kit includes Masimo Tester and SpO2 Sensor Adapter Cable (2021087-001) ■ Nellcor pulse oximeter tester model SRC-2 (2007650-001) ■ Dual BP adapter cable (2005772-001) ■ Nellcor OxiMax pulse oximeter functional tester model SRC-MAX (2007650-002)
NBP test: ■ NBP cuff coupling (400787-001) ■ NBP hose coupling (46100-0020) ■ NBP tee (4745-101) ■ NBP tubing 2 feet (401582-001) ■ Manometer, digital or mercury (Meriam Instrument Smart Manometer model 350 DM2000 or equivalent) ■ NBP tube (414873-001) ■ NBP cuff (9461-301) ■ Pipe, PVC
DEFIB sync test: ■ Unterminated cable assembly (2017842-001) ■ Oscilloscope

Set up

Complete the following steps in the order presented. Failure to attain any of the listed results indicates a malfunction.

1. Confirm that all components of the monitoring system are correctly connected as described in Chapter 3, "Installation" .
   - For Patient Data Module, connect using the ePort host interface cable.
   - For Tram, place the Tram module into the top two slots of the Tram-rac housing.
2. Verify that the power indicator illuminates on the acquisition device.
3. Using the patient simulator and patient cables, configure the monitor display with as many waveforms as possible. Refer to the appropriate patient monitor operator's manual, if necessary.
4. The waveforms should look clean (no noise).

Procedures

Solar 8000M/i Unity View display

NOTE

This check only applies to Solar 8000M systems with product code **3S** and **3T**.

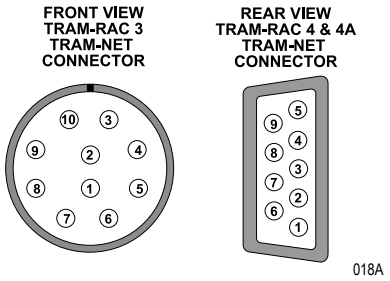
Refer to the specific manufacturer's documentation.

Touchscreen

Verify that touching a parameter box displays the screen information for that parameter.

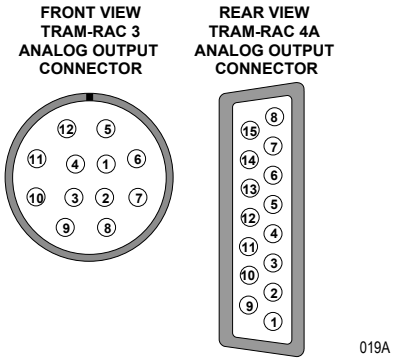
Tram-rac housing

1. Verify that the power LED is ON at the Tram-rac housing.
2. Disconnect and reconnect the Tram-rac housing communication cable. Verify the recovery of the waveforms.
3. If the Tram-rac housing has additional slots for input modules, insert a BP module. Connect simulator and verify communication to the monitor. Repeat for each slot.
4. If the Tram-rac housing has an optional power supply, check the following on the connector that applies to your equipment.



- Verify +16.5V is *not* present at pin 5 of the **TRAM-NET** connector with respect to pin 9.
- Verify +16.5V is *not* present at pin 5 with respect to chassis ground of the Tram-rac housing.

5. The following step does not apply for a Tram-rac 2 housing. Check the analog output connector (yellow) using an oscilloscope. Observe a signal at the appropriate pins found in the next table. The output signal is dependent upon which Tram and input module functions are activated at the monitor.



Analog output signals			
Pins for D-type connector	**Pins for round connector**	**Signal source**	**Tram-rac 4A bezel number for BP output**
Pin 1	Pin 8	Signal GND for Tram Waveforms	–
Pin 2	Pin 2	Trace I (ECG II[1])	Tram[1]
Pin3	Pin 6	Tram BP3 or SPO_2 Value	Tram[1]
Pin 4	–	Reserved for Future Use	–
Pin 5	Pin 4	Tram ART 1 or BP1	Tram
Pin 6	Pin 9	Slot 3 Series 7000 Waveform A (Right Side or Module)	Parameter 6
Pin 7	Pin 11	Slot 4 Series 7000 Waveform A (Right Side or Module)	Parameter 8
Pin 8	Pin 8	Signal GND for Series 7000 Waveforms	–
Pin 9	Pin 1	Tram ECG II	Tram[1]
Pin 10	Pin 3	Tram ECG V	Tram[1]
Pin 11	Pin 7	Tram BP4 or RESP	Tram[1]
Pin 12	–	Reserved for Future Use	–
Pin 13	Pin 5	Tram BP2 or SPO_2 Waveform	Tram
Pin 14	Pin 10	Slot 3 Series 7000 Waveform B (Left Side or Module)	Parameter 5
Pin 15	–	Slot 4 Series 7000 Waveform B (Left Side or Module)	Parameter 7

1. The top displayed trace on the monitor is present unless AVR, AVL, or AVF leads are used, then lead II is output.

M-Port

1. Insert the AutoPort to M-Port adapter into the Port Checkout DIDCA.
2. Connect the M-Port side of the AutoPort to M-Port adapter to one of the M-Ports using the category 5 cable.
3. Verify that the M-Port status LED illuminates green. (LED remains illuminated for a short time after the cable is removed.)
4. Repeat the above steps for all available M-Ports.

If an LED is anything but steady green, refer to Chapter 5, "Troubleshooting" .

TRAM-NET interface or communication

Interface

1. Connect the TRAM-NET interface assembly and device. (Use the appropriate TRAM-NET interface assembly manual and device manual for interconnection directions.)

   Or,

   Connect the Patient Data Module between the ePort connector and the **TRAM-NET 2/ePort** connector on the Solar.
2. Observe correct type of device identified at the monitor.
3. Simulate and observe waveform on monitor.

Communication

1. Connect the Tram-rac housing cable into each of the two TRAM-NET connectors.

   Or,

   Connect the Patient Data Module between the ePort connector and the **TRAM-NET 2/ePort** connector on the Solar.
2. Verify that the waveforms recover on the monitor display each time the cable is reconnected.
3. Verify that the waveforms recover on the monitor display each time the adapter is reconnected.

Unity Network MC network

1. Disconnect the patient cable from the Tram module and verify alarms at the central station.
2. From the MAIN menu, select ***MORE MENUS*** > ***VIEW OTHER PATIENTS*** > ***SELECT A BED TO VIEW***. Verify that the list includes beds other than your own.
3. Select another bed and verify that the selected bed's data is displayed.

Keypad/remote control

1. Plug the keypad or remote control into an M-port.
2. Check all functions of the **TRIM KNOB** control and 18 hard keys. Verify a response at the monitor display.
3. Check that the backlight is on and lights the keys evenly.
4. Activate Boot Code as follows:
   - Hold down **NBP Go/Stop** and **Zero All**.
   - Press and release the **TRIM KNOB** control.
   - Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display.
5. Select ***Tools Menu***.
6. Use password "**mei^**" to open ***Service and Diagnostic Tools Menu***.
7. Select ***M-Port Tools*** > ***Show M-Port #X Serial Incoming Data***. (Where X = the M-Port number.)
8. If the message, "***No incoming data read***" appears, nothing is connected to the **M-Port**. Connect the keypad or remote control or choose the correct **M-Port**.
9. As the columns of numbers scroll, press the keys and **TRIM KNOB** control. Verify that the numbers change as keys are pressed.
10. Exit Boot Code.

Unity Network ID

Unity Network ID connectivity device checkout procedures, see the Unity Network Interface Device (ID) service manual.

Printer

Press **Graph Go/Stop** and verify that the printer responds correctly.

Parameter tests

ECG functions

These procedures test the following:

- Lead and heart rate information displays properly.
- QRS tone sounds.
- Pacemaker mode displays in ECG parameter box.
- Calibration pulses display with correct amplitude.

1. Set up the simulator:
   - Heart rate to 80 bpm.
   - ECG amplitude to 1.0 mV.
2. Attach the patient cable and leadwires between the ECG connector on the acquisition device and the leadwire connectors on the patient simulator.
3. Set up the patient monitor:
   a. Go to ***MORE MENUS > MONITOR SETUP > PARAMETERS ON/OFF*** and turn off all parameters except ***ECG***.
   b. In ***MONITOR SETUP*** select ***WAVEFORMS ON/OFF*** and set leads in the following order:
   - Waveform 1 = ***II***
   - Waveform 2 = ***I***
   - Waveform 3 = ***III***
   - Waveform 4 = ***V1***
   - Waveform 5 = ***AVL***
   - Waveform 6 = ***AVF***

   c. From the ***ECG*** Menu, select ***MORE ECG***, ***QRS VOLUME:*** and set to the desired volume percentage.
4. Admit a patient into patient monitor. (***MORE MENUS > ADMIT MENU > ADMIT PATIENT***)
5. Check that the following conditions are true:
   - The monitor displays ECG lead II, and it is noise-free.
   - The patient monitor displays an 80 ±1 bpm heart rate.
   - The patient monitor QRS audible tone sounds with each QRS complex.
6. Make sure all six ECG leads are available for display and are noise-free.
7. At the patient monitor, select the ECG parameter window to display the ECG menu at the bottom of the screen.
8. Select ***PACE 1:*** or ***PACE 2:***.
9. Inject an asychronous pacemaker pulse with the simulator.

10. Observe the following with leads ***II***, ***III***, ***aVR***, ***aVF***, and ***V***:
    - On the patient monitor, the pacemaker icon with asterisk appears in the ECG parameter box to denote pacemaker mode.
    - The patient monitor still displays an 80 ±1 bpm heart rate.
11. Remove the pacemaker pulse input and return the simulator to these conditions:
    - Heart rate to 80 bpm.
    - Amplitude to 1.0 mV.
12. Select lead ***II*** for display in the top trace position if not already there.
13. Remove the **RA** leadwire from the patient cable.
14. Observe the following:
    - The monitor displays an ***RA FAIL*** message.
    - The monitor displays lead ***III*** in place of lead ***II***.
15. Replace the **RA** leadwire. Observe lead ***II*** in the top trace position again.
16. Print out a graph of ECG 1, lead ***II***.
17. Observe that the waveform pulses are 1mV in amplitude both on the printout and patient monitor display.

12SL™ ECG analysis program functions

1. Connect a 12-lead patient cable to the patient monitor and simulator.
2. At the patient monitor, select the ***ECG*** parameter box.
3. At the ***ECG*** menu, select ***12 LEAD ECG ANALYSIS***.
4. Check that all 12 ECG waveforms display clearly, are noise-free, and display an amplitude equal to the input voltage.

Respiration functions

1. Set up simulator:
    - Set baseline impedance to 750Ω (or 1000Ω if using Marq II).
    - Set Δ (delta) R to 0.5Ω
    - Set lead select to **I** and **II** (or **LL** if using Marq II).
    - Set respiration rate to 30 breaths per minute.
2. Set up the monitor:
    - Turn the respiration waveform ***RR ON***.
    - Set the respiration waveform to lead ***II***.
3. Observe these conditions:
    - The monitor displays a distortion-free respiration waveform.
    - The monitor displays a respiration rate reading of 30 ±2 breaths per minute.
4. Set the respiration waveform to lead ***I*** at the monitor, ***LA*** at the simulator, and observe the same conditions as in step 3.

Invasive blood pressure functions

1. Set up simulator:
   - Go to ***BP*** functions, select ***BP1***, then ***0***.
   - Set output to ***0 mmHg***.
2. Connect the IP simulator cable from the **BP1** connector of the simulator to the corresponding **IP** connection of the acquisition device.
3. Observe an ***ART1*** label and graticules on the patient monitor.
4. Zero the ***ART1*** waveform by pressing the Zero All button on the Patient Data Module, Solar keypad or remote.
5. Set the simulator to output ***240 mmHg***. (***BP1*** > ***STAT*** > ***UP*** > ***RUN***)
6. Observe a reading of ***240*** ± 4 mmHg on the patient monitor.
7. Set the simulator to BP dynamic waveform output. (***BP1*** > ***DYNA*** > ***RUN***)
8. Set the patient monitor ***ART1 SCALES*** to ***AUTO***.
9. Observe a distortion-free waveform and a blood pressure reading of approximately 120/80 (93) on the patient monitor.
10. Repeat these tests with each **IP/BP** connector selecting ***BP2***, ***BP3***, etc.

NOTE

Use the Dual IP Adapter Cable to test the third and fourth IP functionality for each IP/BP connection.

Temperature functions

1. Go to ***TEMP*** functions on the simulator and set a 37°C temperature output.
2. Connect a temperature sensor adaptor to the **TEMP/CO** connector of the acquisition device.
3. Set the switch on the adaptor to the **400** position.
4. Connect the temperature simulator cable from the temperature output connector of simulator to the **T1** connector of the temperature sensor adaptor.
5. Observe that the ***T1*** reading on the patient monitor is between 36.6 and 37.4.
6. Move the cable from the **T1** connector of the temperature sensor adaptor to the **T2** connector.
7. Observe that the ***T2*** reading appears on the patient monitor is between 36.6 and 37.4.
8. Disconnect the temperature sensor adaptor and temperature cable from the acquisition device and the simulator.

Cardiac output functions

1. Connect the cardiac output cable adapter to the **Temp/CO** connector of the acquisition device.
2. Connect the cardiac output adapter to the cardiac output cable adapter and to the simulator.
3. At the patient monitor, go to ***MENUS*** ⇒ ***CO***.
4. Set up the monitor:
   - Set ***AUTO MODE:*** to ***ON***
   - Set ***INJECT TEMP:*** to ***BATH***
   - Set ***SIZE:*** to ***7***
   - Set ***INJECT VOL:*** to ***10CC***
   - Set ***COMPUTATIONAL CONSTANT:*** to ***0.540***
5. Select cardiac output menu corresponding to the injectate temperature. (***CO***)
6. Set the adapter and simulator to ***0°***. Verify that the IT value on the lower left of the display matches the input.

   When computing is complete, the ***CO*** reading on the patient monitor should read approximately ±5% of simulated value.
7. Repeat this test with the adapter and simulator set to ***24°*** and the ***COMPUTATIONAL CONSTANT:*** set to ***0.595***.

   The computed output should be ±5% of simulated value.

SpO_2 functions (Masimo)

1. Connect the Masimo SpO2 tester cable to the SpO2 sensor adapter cable.
2. Connect the SpO2 adapter cable to the SpO2 connector on the acquisition device.
3. Turn the patient monitor on.
4. Verify the following are displayed at the patient monitor: (It might be necessary to turn the SpO_2 parameter on.)
   - A waveform with an SpO_2 label.
   - An SpO_2% reading between 78- 84%.
   - A PRR reading between 60 and 62 beats per minute.
5. Disconnect the simulator cable from the acquisition device.

SpO_2 functions (Nellcor OxiMax)

1. Verify that 2 AA alkaline batteries are installed in the NELLCOR SRC-MAX Pulse Oximetry functional tester.
2. Connect the SRC-MAX to the **SpO_2** connector on the module.
3. On the SRC-MAX, verify that the **IR** and **RED** LED indicators are both lit.

4. Verify the SRC-MAX default indicators are as follows:
   - Heart rate = 60 bpm
   - Light = LOW
   - MOD = LOW
5. Verify the following SpO_2 readings for saturation and pulse rate:
   - Saturation (%): 75 ± 2
   - Rate (bpm): 60 ± 2
6. Press and release the heart rate button on the SRC-MAX. Verify default indicators are lit as follows:
   - Heart rate = 200 bpm
   - Light = LOW
   - %SpO_2 = 75
   - MOD = LOW
7. Verify the following SpO_2 readings for saturation and pulse rate:
   - Saturation (%): 75 ± 2
   - Rate (bpm): 200 ± 3 (194 to 206)
8. Press and release the light button on the SRC-MAX. Verify default indicators are lit as follows:
   - Heart rate = 200 bpm
   - Light = HIGH
   - %SpO_2 = 75
   - MOD = LOW
9. Verify the following SpO_2 readings for saturation and pulse rate:
   - -Saturation (%): 75 ± 2
   - -Rate (bpm): 200 ± 3 (194 to 206)
10. Press and release the **%SpO_2** button on the SRC-MAX. Verify default indicators are lit as follows:
    - Heart rate = 200 bpm
    - Light = HIGH
    - %SpO_2 = 90
    - MOD = LOW
11. Verify the following SpO_2 readings for saturation and pulse rate:
    - Saturation (%):90 ± 2
    - Rate (bpm): 200 ± 3 (194 to 206)

12. Press and release the **MOD** button on the SRC-MAX. Verify default indicators are lit as follows:
    - Heart rate = 200 bpm
    - Light = HIGH
    - %SpO_2 = 90
    - MOD = HIGH
13. Verify the following SpO_2 readings for saturation and pulse rate:
    - Saturation (%):90 ± 2
    - Rate (bpm): 200 ± 3 (194 to 206)

SpO2 functions (Nellcor OxiSmart, Tram only)

1. Connect the Nellcor pulse oximeter SRC-2 to the sensor connector.
2. Make sure that the SRC-2 **IR** and **RED** LED drive indictors are both lit.
3. Set the **RCAL/MODE** switch to **RCAL 63/LOCAL**.
4. Set the **LIGHT** and **MODULATION** switches as follows:
    - Set the **LIGHT** switch to **HIGH 1**.
    - Set the **MODULATION** switch to **HIGH**.
    - Set the **RATE** switch to **112**.

    Allow the Tram a few seconds to obtain a steady reading.
5. Verify the following SpO2 readings for saturation and pulse rate:
    - Saturation (%): 81 ± 2
    - Rate (bpm): 112 ± 2% (110 to 114)
6. Set the **LIGHT** and **MODULATION** switches as follows:
    - Set the **LIGHT** switch to **LOW**.
    - Set the **MODULATION** switch to **LOW**.
    - Set the **RATE** switch to **201**.
7. Verify the following SpO2 readings for saturation and pulse rate:
    - Saturation (%): 81 ± 2
    - Rate (bpm): 201 ± 3% (195 to 207)
8. Set the **LIGHT** and **MODULATION** switches as follows:
    - Set the **LIGHT** switch to **HIGH 2**.
    - Set the **MODULATION** switch to **LOW**.
    - Set the **RATE** switch to **38**.
9. Verify the following SpO2 readings for saturation and pulse rate:
    - Saturation (%): 81 ± 2
    - Rate (bpm): 38 ± 2% (37 to 39)

10. Set the **LIGHT** and **MODULATION** switches as follows:
    - Set the **LIGHT** switch to **LOW**.
    - Set the **MODULATION** switch to **HIGH**.
    - Set the **RATE** switch to **201**.

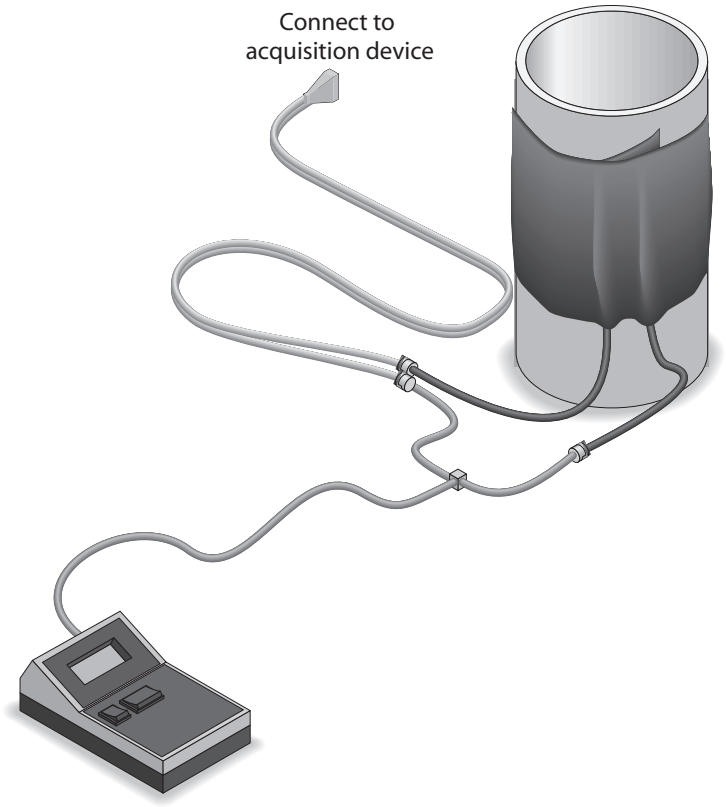
11. Verify the following SpO2 readings for saturation and pulse rate:
    - Saturation (%): 81 ± 2
    - Rate (bpm): 201 ± 3% (195 to 207)

NBP calibration check

1. Connect the acquisition device to the patient monitor.
2. Disconnect all parameter cables.
3. Apply power to the patient monitor.
4. Make sure the power indicator on the acquisition device's front panel is ON (green).

WARNING
Do not put the NBP cuff around a human limb during the checkout procedure due to the potential for injury. When the NBP cuff is used in this procedure, it must be tightly wrapped around a rigid cylinder or pipe.

5. Connect a manometer and NBP cuff to the NBP connector on the front of the acquisition device.



6. Turn the manometer **ON**, and set its range switch to the **1000 mmHg** setting.
7. From the patient monitor Main Menu, select ***MONITOR SETUP*** > ***SERVICE MODE***.
8. Enter the username and password to get into the service mode. The first two digits of the password are the day of the month, and the second two digits are the month. Select ***SERVICE MODE***.
9. Select ***CALIBRATE***.
10. Select ***CALIBRATE NBP***.
11. Select ***CHECK CAL OFF***.
12. Select ***START***.
13. The text in the menu field changes to ***CHECK CAL IN PROGRESS***. Verify that the pressure readings on the patient monitor (shown as ***CUFF*** in the ***NBP*** parameter box) and the manometer are equal (± 1 mmHg) for at least one full minute.
14. If they are equal, the device is properly calibrated.

    If they are not equal, the device requires calibration. Complete this section, then continue with "NBP calibration" below.
15. Select ***CHECK CAL IN PROGRESS***.
16. Select ***STOP***. The module then releases pressure in the cuff.
17. Disconnect the NBP cuff and manometer from the acquisition device.

NBP calibration

1. From the monitor's main menu, select ***MONITOR SETUP***.
2. Select ***SERVICE MODE***.
3. Enter the password to get into the service mode.
   - The first two digits of the password are the day of the month, and the second two digits are the month. For example, on 7 March, the password would be 0703.
   - Select ***SERVICE MODE***
4. Select ***CALIBRATE NBP***.
5. Select ***CAL ZERO OFF***.
6. Select ***START***. The ***CAL ZERO*** menu item shows that it is ***IN PROGRESS*,** and when it is done it displays ***OFF*** again.
7. Reconnect the cuff and manometer to the acquisition device.
8. Select ***CAL GAIN OFF***.
9. Select ***START***.

   The second line of text on the ***CAL GAIN*** menu item changes to ***INFLATING***. Then, the acquisition device starts pumping up the pressure bulb or cuff displayed pressures increase on both the monitor display and the manometer.

The pump shuts off at about 250 mmHg, and the pressure drops slowly to about 240 mmHg before stabilizing. The second line of text on the ***CAL GAIN*** menu item changes from ***INFLATING*** to ***HOLDING***

NOTE

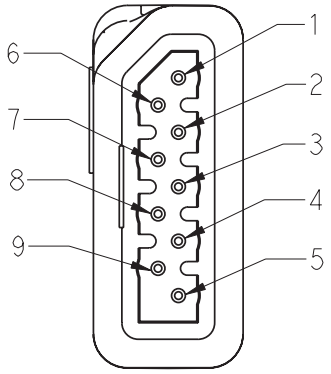
If the pressure continues to drop at a rate of 1 mmHg or more for every five seconds, there is a leak in the NBP plumbing. If there is a leak in the NBP plumbing, correct the problem and restart this calibration procedure.

10. Select ***ENTER CAL PRESSURE***.
11. An ***ENTER CAL PRESSURE*** popup window appears. Use the **Trim Knob** control to select a pressure value that is 1 mmHg lower than the current manometer reading.
12. When the manometer falls to exactly the value that you selected in the popup window, press the **Trim Knob** control to enter the value. Select ***PREVIOUS MENU*** to return to the ***MAIN MENU*** button.
13. Select ***CHECK CAL OFF***.
14. Select ***START***.
15. The text on the menu item changes from ***CHECK CAL OFF*** to ***CHECK CAL IN PROGRESS***. Make sure that the pressure readings (shown as ***CUFF*** in the NBP parameter box) on the monitor display and manometer are equal (± 1 mmHg) for at least one full minute.
16. Select ***CHECK CAL IN PROGRESS***.
17. Select ***STOP***. The module then releases pressure in the bulb or cuff.
18. Remove the cuff and manometer from the acquisition device.

Defib/sync and analog output test

Patient Data Module

1. Connect the unterminated cable assembly to the **Defib/Sync** connector on the front of the Patient Data Module.
2. Set up the simulator:
   - Heart rate = 80 bpm
   - Amplitude to 1.0 mV
3. Test the ECG, Arterial BP, and Marker Out signals from the **DEFIB SYNC** connector using an oscilloscope to connect to the appropriate wire on the test cable (shown below). They should resemble the waveforms in the following figures. Note that there are two Marker Out traces shown. The top trace shows the frequency of the pulses; the bottom trace shows the pulse width.



450B

Test Cable Plug and Pinout

Pin	Wire Color	Signal Name
1	Brown	ECG_ANALOG_OUT
2	Red	BP_ANALOG_OUT
3	Orange	NO_CONNECTION
4	Yellow	MARKER_RETURN
5	Shield	DRAIN WIRE
6	Green	ANALOG_RETURN
7	Blue	NO_CONNECTION
8	Violet	DEFIB_SYNC_MARKER_IN
9	Gray	DEFIB_SYNC_MARKER_OUT

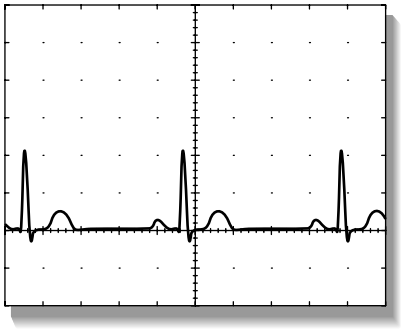
ECG

Signal pin: **1** Brown wire

Ground pin: **6** Green wire

Time/division: **0.2s**

Volts/division: **0.5v**



023A

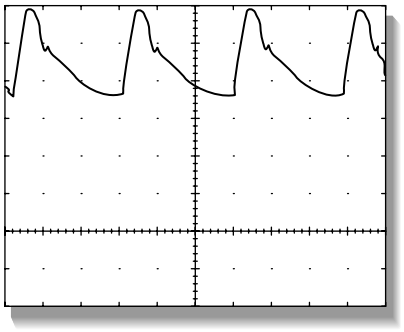
Arterial BP

Signal pin: **2** Red wire

Ground pin: **6** Green wire

Time/division: **0.2s**

Volts/division: **0.2v**



024A

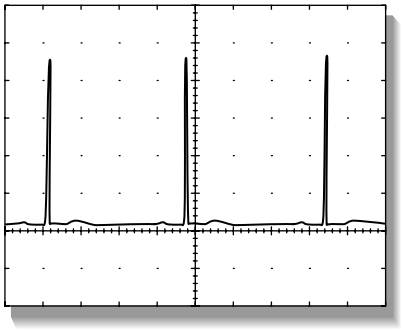
Marker Out (Frequency)

Signal pin: **9** Gray wire

Ground pin: **4** Yellow wire

Time/division: **10ms**

Volts/division: **0.5v**



025A

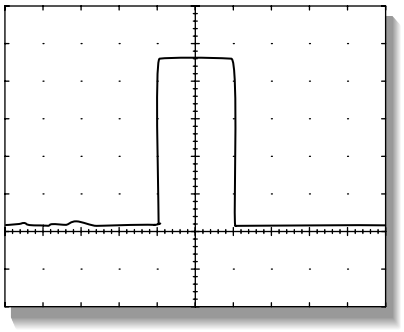
Marker Out (Pulse Width)

Signal pin: **9** Gray wire

Ground pin: **4** Yellow wire

Time/division: **5ms**

Volts/division: **1v**

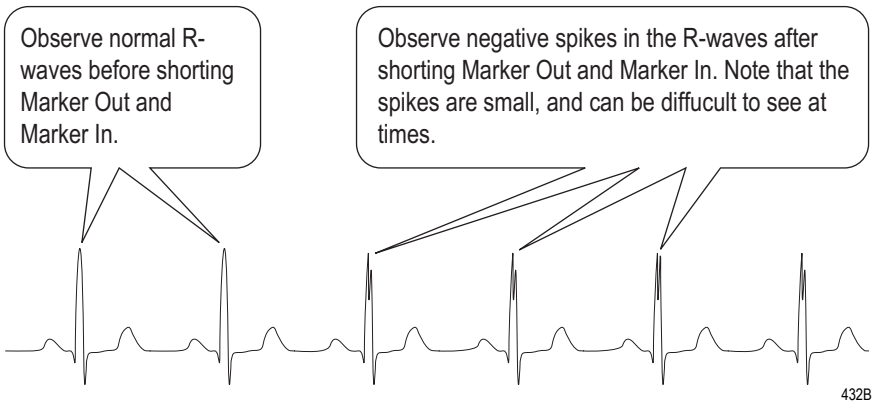


026A

NOTE

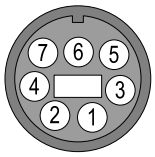
The Marker Out amplitude and pulse width are configured at 10v and 10ms respectively from the factory.

4. Short the gray wire (Marker Out) to the violet wire (Marker In) and observe negative spikes in the R-waves of the displayed ECG waveforms.


Observe normal R-waves before shorting Marker Out and Marker In.
Observe negative spikes in the R-waves after shorting Marker Out and Marker In. Note that the spikes are small, and can be diffucult to see at times.
432B

Tram module

1. Connect an oscilloscope to the **DEFIB SYNC** connector on the front panel of the Tram module.
2. Test the ECG, Arterial BP, and Marker Out signals from the **DEFIB SYNC** connector. They should resemble the waveforms in the following figure. Note that there are two Marker Out traces shown. The top trace shows the frequency of the pulses; the bottom trace shows the pulse width.

Defibrillator Synchronization connector J2			
Pin	**Name**	**Descriptions**	
1	DEFIB_MARKER_OUT	Digital defibrillator output synchronization signal	 **Front View of Module**
2	DEFIB_MARKER_IN	Digital defibrillator input signal	
3	AGND1	Signal Ground	
4	DGND	Signal Ground	
5	AGND2	Signal Ground	
6	BP_ANALOG_OUTPUT	Analog BP/OUTPUT	
7	ECG_ANALOG_OUTPUT	Analog ECG output signal	

039A

ECG

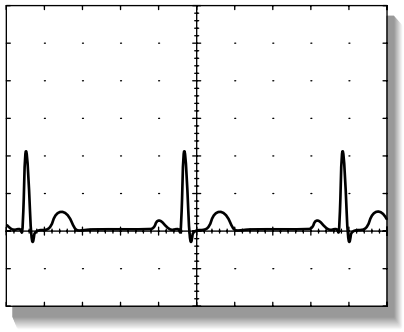
Signal Pin: **7**

Ground Pin: **3**

Probe Type: **x10**

Time/Division: **0.2S**

Volts/Division: **0.5V**



Arterial BP

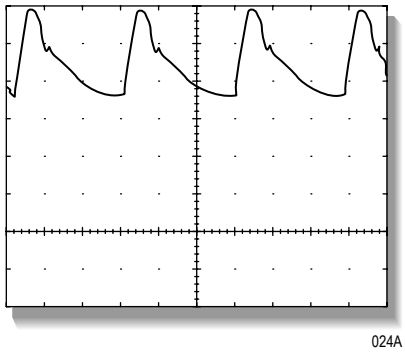
Signal Pin: **6**

Ground Pin: **5**

Probe Type: **x10**

Time/Division: **0.2S**

Volts/Division: **0.2V**



NOTE

The Marker Out amplitude and pulse width are configured at 5V and 10ms respectively from the factory. To change these settings refer to the Calibration chapter of your TRAM modules service manual.

Marker Out (Frequency)

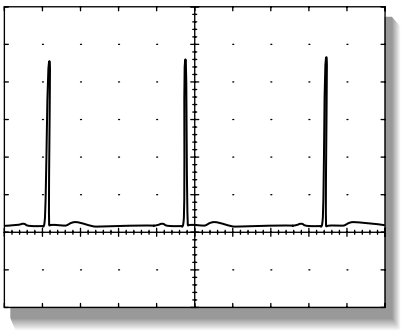
Signal Pin: **1**

Ground Pin: **4**

Probe Type: **x10**

Time/Division: **0.2S**

Volts/Division: **1V**



025A

Marker Out (Pulse Width)

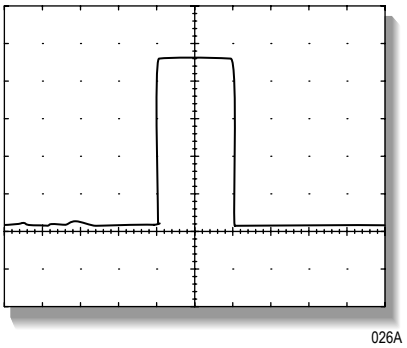
Signal Pin: **1**

Ground Pin: **4**

Probe Type: **x10**

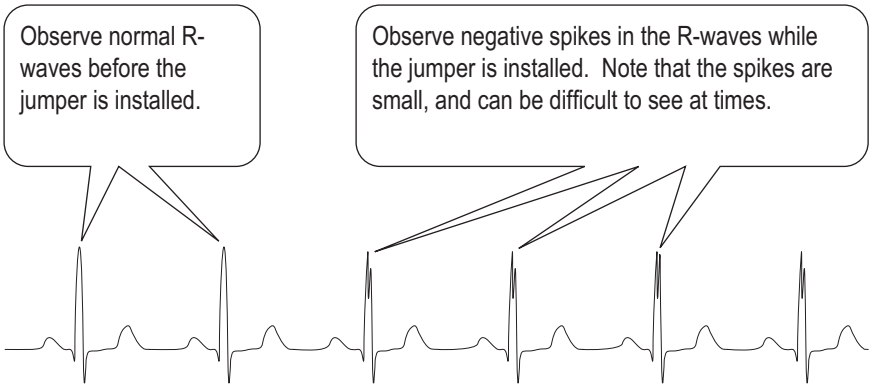
Time/Division: **5mS**

Volts/Division: **1V**



026A

3. Attach a jumper between pin 1 (Marker Out) and pin 2 (Marker In) of the **DEFIB SYNC** connector and observe negative spikes in the R-waves of the displayed ECG waveforms.


Observe normal R-waves before the jumper is installed.
Observe negative spikes in the R-waves while the jumper is installed. Note that the spikes are small, and can be difficult to see at times.

040A

4. Remove the jumper.

Completion

- Test additional modules using procedures found in the service manual that accompanied the module.
- Disconnect all test equipment.
- Return the monitor and acquisition device to service.

Maintenance Checklist

Use the following checklist to ensure maintenance completion.

“Visual inspection” on page 4-3

1. ____ General
2. ____ Connectors
3. ____ Display

“Cleaning” on page 4-4

1. ____ Exterior cleaning
2. ____ Cleaning the display
3. ____ Cleaning the touch screen display
4. ____ Cleaning disinfecting and storing GE ECG cables and leadwires

“Electrical safety tests” on page 4-8

1. ____ Power outlet test
2. ____ Ground (earth) integrity
3. ____ Ground (earth) wire leakage current tests
4. ____ Enclosure leakage current test
5. ____ Patient (source) leakage current test
6. ____ Patient (sink) leakage current test

“Checkout procedure” on page 4-16

1. ____ Solar 8000M/i Unity View display
2. ____ Touchscreen
3. ____ Tram-rac housing
4. ____ M-Port
5. ____ TRAM-NET interface or communication
6. ____ Unity Network MC network
7. ____ Keypad/remote control
8. ____ Unity Network ID
9. ____ Printer

“Parameter tests” on page 4-22

1. ____ ECG functions
2. ____ 12SL™ ECG analysis program functions
3. ____ Respiration functions
4. ____ Invasive blood pressure functions
5. ____ Temperature functions
6. ____ Cardiac output functions
7. ____ SpO2 functions (Masimo)

   ____ SpO2 functions (Nellcor OxiMax)

   ____ SpO2 functions (Nellcor OxiSmart, Tram only)
8. ____ NBP calibration check
9. ____ Defib/sync and analog output test (Patient Data Module)

   ____ Defib/sync and analog output test (Tram Module)

Repair Log

Unit serial number:
Institution name:

Date	Maintenance or repair	Technician

5 Troubleshooting

Terms used

Listed and defined below are terms used in this chapter.

Abort (main code)

This is a Main Code menu selection that may appear on the monitor during software downloads from the monitor ***SERVICE MODE*** menu. ***ABORT*** causes the download to stop by pushing the **TRIM KNOB** control.

Boot loader or boot code

The Boot Loader or Boot Code is used to download software. Entering the Boot Code does not erase any memory, but downloading new software will erase protected memory. To activate the Boot Code, perform the following.

1. Hold down **NBP Go/Stop** and **Zero All**.
2. Press and release the **TRIM KNOB** control.
3. Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display.

Cold start

A cold start is used only in extreme circumstances. It erases the protected memory, language, unit name and bed number; automatically discharges the patient; and restores factory defaults. Ethernet address, internet address, software feature level, and CRG trend option remain unchanged.

1. Hold down **NBP Go/Stop** and **Zero All**.
2. Press and release the **TRIM KNOB** control and keep holding **NBP Go/Stop** and **Zero All**.
3. When the monitor resets and the display goes blank, press and hold **Display On/Off** (in addition to **NBP Go/Stop** and **Zero All**) until the message "***performing cold start***" appears on the display.

NOTE

If the Boot Code information appears before the message "***performing cold start"*** appears, begin the cold start again.

Continue (main code)

CONTINUE is a Main Code menu selection that appears after a successful software download. It allows the user to continue downloading other files without resetting the monitor.

Monitor memory

Monitor memory contains the Ethernet address, internet address, bed name, care unit name, and standard unit defaults for each monitor.

Protected memory

Protected memory contains a patient's history and any individualized changes to the unit defaults.

Power cycle or reboot

To power cycle or reboot the monitor, turn the power OFF at the rear of the unit, wait 10 seconds, then turn the power ON.

Service mode (main code)

The ***SERVICE MODE*** menu is found in the monitor ***MAIN*** menu and is used for various functions like calibration, video tests, and downloading monitor interface software. (See details later in this chapter.)

Service menu (boot code)

The Service Menu found in the Boot Code is used when downloading the Boot Code and main processor code. (See details later in this chapter.)

Warm start (boot code)

A warm start activates the software previously downloaded. The following steps activates a warm start.

1. Hold down **NBP Go/Stop** and **Zero All**.
2. Press and release the **TRIM KNOB** control.
3. Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display.
4. Select ***Start Patient Monitoring***.

Country selection

This is a Boot Code setting. The choices are ***France***, ***Germany***, or ***Default*** which chooses a particular set of GE factory defaults. These defaults are used when changing the unit type (Adult-ICU, OR, or Neonatal).

Set language

This is a Boot Code setting. It sets the language for displayed text in the Main Code. (Do not confuse with ***Country Selection***.)

Service menus

The Boot Code ***Service Menu*** and Main Code ***SERVICE MODE*** menu are generally used by qualified field engineers and factory service personnel to troubleshoot, repair, or download new software to the patient monitor.

WARNING
The Boot Code service menu or ***SERVICE MODE*** menu is intended for qualified personnel only. It is possible to lose patient data, damage the operating software for this monitor, and even affect the Unity Network. Do not 'experiment' with any commands found in the service menus.

Boot code *Service Menu*

Use the Boot Code service menu when downloading new Boot Code or Main Code software to the patient monitor or when the patient monitor exhibits a serious failure. Activate the Boot Code program as follows:

1. Hold down **NBP Go/Stop** and **Zero All** on the keypad or remote control.
2. Press and release the **TRIM KNOB** control.
3. Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display.

Set up first Ethernet Port

This menu selection allows changes to the Ethernet address, gateway address, and internet mask.

WARNING
Duplication of an Ethernet address on a network causes data loss and possible Unity Network problems. If you change the factory assigned Ethernet address, you must record all other Ethernet addresses used on your network to avoid duplication.

Set up second Ethernet Port

Same as ***Set up first Ethernet Port***.

Clear Monitor Memory

If you respond with ***YES*** in this option, you will erase all patient histories and programmed defaults in the protected memory and return to factory installed defaults.

Set Configuration

This menu contains options for defib sync for ECG modules (not Tram modules), line frequency, country selection (not for text translations), and setting language for displayed text.

WARNING
Changing the language will discharge the monitor and erase any saved monitor defaults. The monitor defaults will be set to the factory defaults.

Serial Download Main

This option is used when downloading software from a laptop PC.

Serial Download Boot

This option is used when downloading software from a laptop PC.

View Main Code Error Logs

Allows access to the error logs generated by the Main Code.

Tools Menu

This password protected menu contains service diagnostic tools. Use password "**mei^**".

Video Test Screens

Various color screens for testing the display.

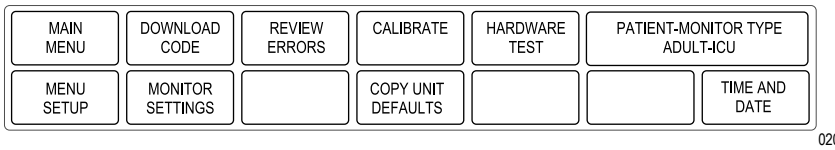
Options Menu

In this menu, you can enable various software options (Hires Trends, Cardiopulmonary Features, etc.) and change the monitor software level. A unique password is required for each option and to change the software level or Ethernet address. Fax a password request to GE Customer Relationship Center at (414) 362-3250 to obtain a password. You must provide your product serial number and Ethernet address. (The Ethernet address displays in the Boot Code banner information.)

Main code *SERVICE MODE* menu

Access the ***SERVICE MODE*** menu starting from the ***MAIN*** menu.

1. Select ***MORE MENUS*** > ***MONITOR SETUP*** > ***SERVICE MODE***.
2. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros. (e.g. July 4 = 0407).



DOWNLOAD CODE

This menu provides options for downloading SpO_2, RAC COMM/DAS, SAM, and CO_2 modules.

CALIBRATE

These menu selections are used to calibrate the touchscreen and various inputs from the Tram module, Patient Data Module, or other discrete modules. Refer to the module service manual for details. See Chapter 6, "Configuration" , for calibration details.

HARDWARE TEST

This menu provides access to the hardware tests for the monitor.

Hardware Status

The 'one of a kind' patient monitor LAN address is listed here. The current revision of the main processor and FPGA are also listed.

Video Test

WARNING
Loss of patient data. Do not enter this menu selection unless loss of patient data is not an issue.

Provides a list of various test patterns and colors that can be used to calibrate the display. When finished, select ***RESTART System***.

PATIENT-MONITOR TYPE

Select the type of monitor desired, i.e., adult, neonatal or operating room. See Chapter 6, "Configuration" , for detailed procedures.

WARNING
Changing the patient-monitor type will default the admit function to ***STANDARD*** configuration. Different alarms and parameters are activated for each selection.

NOTE
The keypad/remote control is DIDCA programmed for specific monitor types. The error message ***WARNING: REMOTE MISMATCHED WITH MONITORING MODE*** displays if the monitor and keypad/remote control do not match.

MENU SETUP

This menu selection provides the following submenus: (See Chapter 6, "Configuration" , for detailed procedures.)

ADMIT MENU: STANDARD
This menu selection allows you to determine the function of the patient monitor. The four variables include stationary or ambulatory (telemetry) patient monitoring with a monitor that always stays in one room (***STANDARD***) or a monitor that moves from room to room (***ROVER***).

SOFTWARE LEVEL
This menu selection displays the software feature level this monitor is using. It allows setting the level to a lower setting than the software feature level setting in Boot Code.

MONITOR DEFAULTS PASSWD
This menu selection is used to turn a password requirement ***ON*** or ***OFF*** for entry into the ***MONITOR DEFAULTS*** menu section described above. If selected, the password will be the same as the ***SERVICE MODE MENU*** password.

MONITOR SETTINGS

This menu selection provides the following submenus: (See Chapter 6, "Configuration" , for detailed procedures.)

SET UNIT NAME

This menu selection allows changes to the care unit name. After initial setup, this name should not be changed or communication to the central station will be corrupted. Note that the care unit name must be registered exactly the same in the central station and the patient monitor.

SET BED NUMBER

This menu selection allows changes to the bed number. After initial setup, this number should not be changed or communication to the central station will be corrupted. Note that the bed number must be registered exactly the same in the central station and the patient monitor.

SET LOCATION ID

Enter the location identification for the MUSE system.

SET SITE NUMBER

A site number may be necessary if your institution has multiple buildings. A MUSE system can be used as a site number.

STORE DEFAULTS FOR NETWORK TRANSFER

This menu selection saves the monitor defaults for transfer to another monitor with the same software, patient monitor type, and country code. It stores all monitor defaults, custom default names, and 12 SL location and site.

SET INTERNET ADDRESS

This menu selection allows changes to the internet (IP) address.

WARNING
Duplication of an internet (IP) address on a network causes lost data. If you change the factory assigned internet address, you must first record all other internet addresses used on your network to avoid duplication.

An incorrect internet address may also prevent the monitor from viewing other monitors on the network. Whether or not this can occur depends on the network topology at the installed site.

COPY UNIT DEFAULTS

This menu option is used to copy monitor defaults from one monitor to another monitor. See Chapter 6, "Configuration" , for detailed procedures.

TIME AND DATE

This menu selection allows changes to the time and date and may affect the time and date for the entire monitoring network. Refer to Chapter 6, Configuration, for detailed procedures.

WARNING
Loss of patient history. This menu should rarely be used because patient histories will be lost.

Fault analysis

Overview

The problems and solutions in this chapter represent only a few of the faults that you may encounter and are not intended to cover every possible problem that may occur.

A systematic approach to the diagnosis of problems as well as a general understanding of the architecture, both hardware and software, of the patient monitor are essential to ensure successful troubleshooting of a device. GE recommends formal service training before repairs are attempted. These troubleshooting procedures combined with training provide the service technician with skills necessary to service and repair a patient monitor in the event of a malfunction.

Before starting any detailed troubleshooting, complete a thorough visual inspection of the following:

- All cable connections secure?
- Devices properly powered?
- Connected to a proper power source?
- Correct Ethernet and internet addresses?
- No duplication of internet addresses and LAN addresses on the network.

Calibration

The Solar 8000M/i patient monitor is factory calibrated and requires no calibration in the field. The only field adjustable switch is **S1** on the power supply. It selects the range for the AC mains input, but should not need to be changed.

AC line voltage test

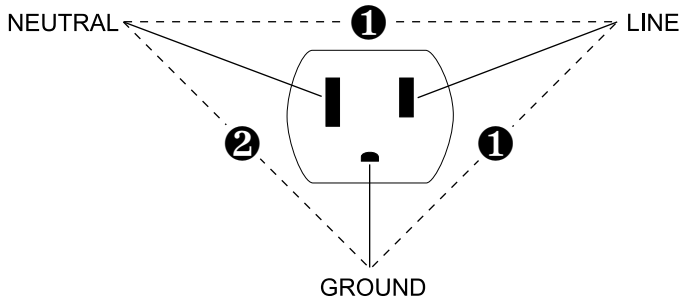
This test verifies that the domestic wall outlet supplying power to the equipment is properly wired. For international wiring tests, refer to the internal standards agencies of that particular country.

Set the **ON/OFF** switch to the **OFF** position and disconnect the monitor from its power source.

120 VAC, 50/60 Hz

Use a digital voltmeter to check the voltages of the 120-volt AC wall outlet (dedicated circuit recommended). If the measurements are significantly out of range, have a qualified electrician repair the outlet. The voltage measurements should be as follows:

1. 120 VAC (± 10 VAC) between the line contact and neutral and between the line contact and ground.
2. Less than 3 VAC between neutral and ground.

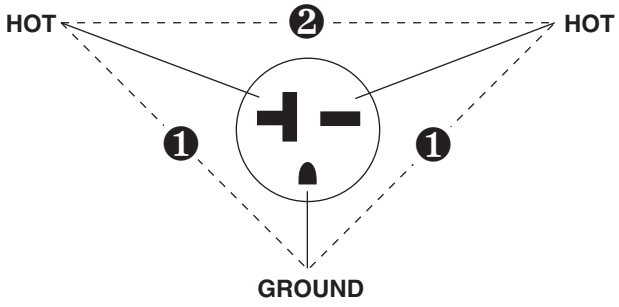


021A

240 VAC, 50/60 Hz

Use a digital voltmeter, set to measure at least 300 VAC, to check the voltages of the NEMA 6-20R, AC wall outlet (dedicated circuit recommended). If the measurements are significantly out of range, have a qualified electrician repair the outlet. The voltage measurements should be as follows:

1. 120 VAC (± 10 VAC) between either “hot” contact and ground.
2. 210 to 230 VAC between the two “hot” contacts.



022A

Troubleshooting procedure

Many network problems at the central station are traced back to the patient monitor or Tram-rac housing. Therefore, many of the troubleshooting suggestions in the “Problems and Solutions” section include replacing pcb assemblies in the patient monitor or Tram-rac housing. The “LED Troubleshooting Table” explains the normal condition of the various LEDs on the pcb assemblies.

Do not perform the procedures listed unless you are a trained field or biomedical engineer. Refer to “Disassembly” on page 7-7 for circuit board functions. To aid in disassembly of the unit, refer to “Disassembly” on page 7-7.

WARNING
Patient data loss. This procedure is intended for use by service personnel with advanced troubleshooting skills. The consequences of the following steps may cause loss of patient data and disruption of the entire Unity Network.

Problems and solutions

Problem	Possible Reason and Solution
The display is blank.	The video display has no power. Verify that the display's power indicator is illuminated. The patient monitor has no power. Verify that the patient monitor's power indicator is illuminated. The video display is not properly connected to the patient monitor. Verify that the correct cable connects the video display to one of the 4 video ports on the patient monitor. The display was turned off via the **Display On/Off** button on the keypad/remote control. Press the **Display On/Off** button on the keypad/remote control. Hardware failure. 1. The SDRAM test performed by Boot Code failed.Check the **LS6** LED (I'm OK). If the SDRAM test failed, it will continually flash error codes. ■ Error codes always start with 3 very short pulses in quick succession. ■ Binary 1s are long ON pulses. ■ Binary 0s are short ON pulses. ■ The first digit is the most significant. ■ There are 6 binary digits per error code. ■ A short pause occurs between the first 4 binary digits and the last 2 binary digits. If you observe error codes, replace the processor pcb. 2. Boot Code not loaded properly or is corrupt. This may be the case if the I'm OK LED is stuck ON or OFF. Replace the processor pcb. 3. Power supply failure. Replace the power supply. 4. Loose connections to power supply. Tighten connections. 5. Excessive loading on external connector due to malfunctioning peripheral device. Isolate and replace the malfunctioning device. 6. Other. Replace the power supply. 7. Power supply replaced, but display still doesn't work. Replace processor pcb.
Boot Code starts, but Main Code does not.	1. Check the boot banner for hardware test results. The following information is available: ■ SRAM test results (passed or failed) ■ SDRAM test results (passed or failed) ■ Main flash check (passed or failed) ■ Boot flash check (passed or failed) ■ Real time clock (is running or failed) If any of the above is failed, then Boot Code refuses to run the Main Code. Cycle power on the patient monitor and it may correct itself. 2. Attempt to start Main Code via the "return to Patient Monitoring". One of the following may be the problem: ■ Main Code not loaded. Follow the software installation instructions to download Main Code. (These instructions ship with the software upgrade kit.) ■ Main Code and Boot Code not compatible. Follow the software installation instructions to update the Boot Code to a version compatible with the Main Code. (These instructions ship with the software upgrade kit.) 3. If the problem is still not corrected, replace the processor pcb.
The quality of the display is not good.	Check the connection between the video display and the patient monitor and correct, if necessary, or replace the video display with a known good one. If the problem is not corrected, replace the processor pcb.

Problem	Possible Reason and Solution
Tram module patient data does not display.	1. Verify correct patient or simulator leadwire connections to the Tram module in Tram-rac housing. 2. Verify that the Tram module is completely inserted and ON. 3. Verify that the Tram-rac housing is turned ON. 4. Select the ***SOFTWARE REVISION*** menu and verify that the ***RAC COMM***, ***RAC DAS***, or ***TRAM MODULE*** software file numbers are there. ■ If ***INCOMPATIBLE SOFTWARE REV*** message displays, refer to "Change software level" on page 6-10. ■ Check for a loose or faulty cable from the patient monitor to the Tram-rac housing. ■ Cycle power to the Tram-rac housing. ■ View error logs for TRAM module and patient monitor. Refer to "Reviewing error/event logs" on page 5-22. ■ Replace Tram module with a known good one. ■ Replace Tram-rac housing with a known good one.
Patient Data Module does not display patient data.	1. Verify correct patient or simulator leadwire connections to the Patient Data Module. 2. Verify that the Patient Data Module is completely inserted into the docking station and is ON. 3. Check for a loose or faulty cable from the patient monitor to the Patient Data Module. 4. View error logs for the patient monitor. Refer to "Reviewing error/event logs" on page 5-22. 5. View error logs for the Patient Data Module. See the Patient Data Module service manual. 6. Replace the Patient Data Module with a known good one.
Patient alarms are not sounding when activated.	1. If a patient's waveform and the ***DISCHARGED*** message both display, consult the operator's manual for correct patient admitting instructions. The alarm function remains disabled until the patient is correctly admitted into the system. 2. Make sure the alarms are enabled. Consult the operator's manual for correct alarm settings. 3. Verify that the alarm volume is not turned off. Look in ***ALARM CONTROL*** > ***ALARM VOL***: 4. Test if the speaker is functioning, using the ***LEARN THE MONITOR*** menu option.
Patient alarms are not sounding at the desired central station.	The alarm function remains disabled until the patient is correctly admitted into the system. 1. If ***DISCHARGED*** message displays, consult the operator's manual for correct patient admitting instructions. 2. If the monitor was moved from one care unit to another, reprogram the alarm destinations. ■ Watch for misspelling or spaces in the name. ■ Make sure that the care unit name programmed into the monitor and central station match exactly. Typically, the care unit name for a monitor is not shown on the central station display of a patient's data. Only the bed number is shown. If the care unit name for a monitor does not match the central station care unit name, then the monitor identification changes. The monitor identifier shows the care unit name followed by a vertical slash (|) and then the bed number. The solution is to modify the monitor care unit name to match the central station's care unit name. 3. Force an alarm from another monitor to test if the speaker is functioning.
Patient data from the Solar 8000M/i does not display at the central station.	If the central station displays a ***NO COMM*** message for one patient, do the following: ■ Cycle power to the Solar 8000M/i processing unit. ■ Check for a loose connection between the patient monitor and the Ethernet cable. ■ View error logs for ***TRAM*** and the monitor. Refer to "Reviewing error/event logs" on page 5-22. ■ An incorrect LAN address was programmed into the monitor. Refer to "Configuring a patient monitor" on page 6-2. ■ Verify operation of the processor pcb with the "LED Troubleshooting Table."

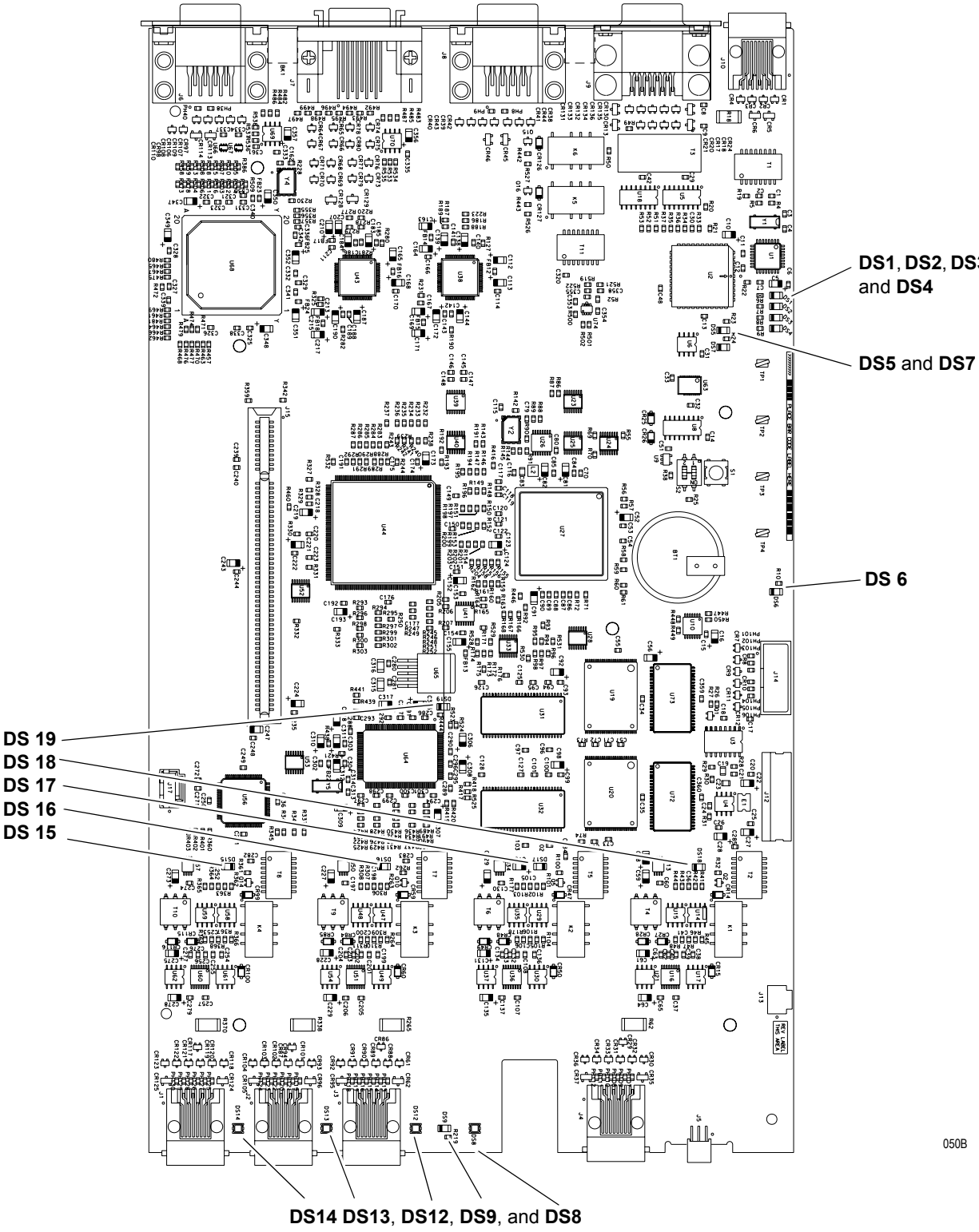
Problem	Possible Reason and Solution
Graphs and alarms are not printed at the desired location.	1. Verify paper in central station writer is correct side up. 2. If the monitor was moved from one care unit to another, reprogram the graph destinations. Refer to "Set graph locations" on page 6-5. ■ Watch for misspelling or spaces in the name. ■ Make sure that the care unit name programmed into the monitor and central station match exactly. Typically, the care unit name for a monitor is not shown on the central station display of a patient's data. Only the bed number is shown. If the care unit name for a monitor does not match the central station care unit name, then the monitor identification changes. The monitor identifier shows the care unit name followed by a vertical slash (|) and then the bed number. The solution is to modify the monitor care unit name to match the central station's care unit name.
The remote control does not activate the display.	This is caused by an interruption of power to the remote control. 1. Check the **M-Port** LED. If it is illuminated, the remote is communicating with the patient monitor. 2. Check for a loose connection from the monitor to the remote control. 3. Try a different **M-port**. 4. Disconnect and securely reconnect the remote control from the monitor to reset the remote control. 5. Replace remote control with a known good one. 6. Replace processor pcb in patient monitor with a known good one.

LED troubleshooting

The following table describes the function and normal condition of the patient monitor LEDs to aid in troubleshooting.

LED/Color	Signal name	Function	Normal condition
TRAM-NET LEDs on processor PCB			
DS7/Yellow	Network Activity	"I hear all talking on TRAM-NET"	ON steady or flickers
DS5/Red	Jabber Detect	"I detect excessive talking on TRAM-NET"	OFF if all hub ports OK
Unity Ethernet LEDs on processor PCB			
DS1/Green	Transmit	"I am talking on Ethernet"	Flashes when transmitting
DS2/Yellow	Receive	"I am listening to Ethernet."	Flashes when receiving
DS3/Red	Collision Detect	"I detect collisions on Ethernet."	ON when detecting collision
DS4/Green	Link	"I hear all talking on Ethernet."	ON when receive path is OK from hub to the Solar 8000M/i
M-Port Ethernet LEDs on processor PCB			
DS15/Green	Link	"I hear all talking on Ethernet."	ON when receive path is OK from hub to the Solar 8000M/i M-Port
DS16/Green	Link	"I hear all talking on Ethernet."	ON when receive path is OK from hub to the Solar 8000M/i M-Port
DS17/Green	Link	"I hear all talking on Ethernet."	ON when receive path is OK from hub to the Solar 8000M/i M-Port
DS18/Green	Link	"I hear all talking on Ethernet."	ON when receive path is OK from hub to the Solar 8000M/i M-Port
DS19Green	Link	"I hear all talking on Ethernet."	ON when receive path is OK from hub to the Solar 8000M/i M-Port
Processor LEDs on processor PCB			
DS9/Green	Power	"+3.3V is applied to PCB."	ON steady
DS6/Green	"I am OK LED"	"Main processor PCB is OK.''	Flashes at ≈ 1-2 Hz

M-Port Status LEDs DS14, DS13, DS12, DS8 on processor PCB	
State	**Description**
Solid green	Indicates the device is communicating properly.
Slow flashing yellow	Indicates the device has been identified, but there is no communication.
Flashing yellow	Indicates that too many identical devices are connected or the device cannot be identified.


DS1, DS2, DS3, and DS4
DS5 and DS7
DS 6
DS 19
DS 18
DS 17
DS 16
DS 15
DS14 DS13, DS12, DS9, and DS8
050B

LED/Color	Signal name	Function	Normal condition
TRAM-NET LEDs on Tram-rac processor PCB in the Tram-rac housing			
DS1/Green	Power	"+5V is OK to PCB"	ON steady
DS2/Red	Network Activity	"I hear all talking on TRAM-NET"	ON mostly steady with Tram-rac connected or flickers LOW with no Tram-rac connected
DS3/Green	Transmit Enable	"I am talking on TRAM-NET"	Flickers ON with red LED[1] ON steady while graphing
DS4/Yellow	Error Detect	"I detect an error on this PCB"	OFF
DS6/Red	Rac COMM	"Tram-rac 4 processor PCB is OK"	Flashes opposite DS5 (twice per second)
DS5/Red	Rac DAS	"Data acquisition PCB is OK"	Flashes opposite DS6 (twice per second)

1. Because "I hear when I am talking," the "talking" LED flashes with the "hearing" LED, but the "hearing" LED will also flash alone when it "hears someone else talking."

Troubleshooting software updates

The following is a list of problems commonly encountered during a software update with their solutions.

Problem	Possible reason and solution
Monitor appears 'locked up' during a network download.	**CAUTION** Do not power cycle or reboot the monitor if downloading the Boot Code is proceeding normally. The monitor will be rendered useless. If the packet or byte numbers stop advancing for at least two minutes, do the following: 1. Check that all cables are properly connected. 2. At the patient monitor: ■ Hold down **NBP Go/Stop** and **Zero All**. ■ Press and release the **TRIM KNOB** control. ■ Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display. 3. Repeat the software update procedure for the aborted file from the beginning.
Software revision window does not list part numbers.	If the part numbers are not listed for the monitor interfaces in the software revision window, the software update has not been activated. Power cycle the monitor and view the software revisions window again. If the part numbers are still missing, repeat the update procedure for each missing file.
Waveforms do not appear at the central station.	If communication is corrupted, do the following: 1. Check all cables for a good connection. 2. Ensure that the central station software is correct. 3. Ensure Ethernet addresses have been programed correctly. Refer to the appropriate service manual. 4. Ensure the Ethernet address has been programmed correctly at the patient monitor: ■ Hold down **NBP Go/Stop** and **Zero All**. ■ Press and release the **TRIM KNOB** control. ■ Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display. ■ The Ethernet address displays in the Boot Code banner information. 5. If the Ethernet address needs to be changed in Boot Code, a unique password is required to access ***Change Ethernet Address*** in the ***Options Menu***. Fax a password request to GE Customer Relationship Center at 877-633-8181 to obtain a password. You will need to provide your product serial number and Ethernet address. (The Ethernet address displays in the Boot Code banner information.)

Error messages

The following table describes error messages that may appear on the display and how to resolve the problem.

Message	Possible reason and solution
"***WARNING: The EEPROM data was found to be either INVALID or uninitialized. GE Medical Systems Information Technologies factory defaults will be stored in both the EEPROM and the monitor's configuration memory. You will be required to re-enter the network configuration, re-enable any password protected features and restore all monitor settings and site-specific defaults.***"	Following the EEPROM dump, restore data: 1. Restore Ethernet address and IP address as requested by the Boot Code. 2. Power cycle. 3. If error message persists, replace processor pcb. If error message no longer occurs, re-enable any password protected features and restore all monitor settings and site-specific defaults via ***SERVICE MENU*** -> ***Set Configuration***, and ***Options Menu***.
"***ERROR: THE INTERNAL BATTERY THAT MAINTAINS THE MONITOR'S DEFAULTS HAS FAILED!"*** **** * SERVICE MAY BE REQUIRED * ****	Check switch **S2-2**. Battery may be depleted. Replace the processor pcb. (See chapter 7, Upper Level Assembly, Disassembly Guidelines for the Processor Board.)
"***WARNING: The last attempt to load Main Code failed. The checksum calculated for the SDRAM did not match what was expected. If this problem occurs repeatedly, your monitor may need to be serviced.***"	1. Power cycle. 2. If problems persists, replace processor pcb.
"***WARNING: THIS VERSION OF BOOT CODE IS NOT COMPATIBLE WITH THE VERSION OF MAIN CODE CURRENTLY STORED IN FLASH. PLEASE UPDATE THE BOOT CODE.***"	1. Power cycle. 2. Reload Boot Code. 3. If problems persists, replace processor pcb.
"***Boot Flash test FAILED.***" "***ERROR: The Boot Code stored in Flash is not valid. Main Code cannot be loaded until valid Boot Code exists.***"	1. Power cycle. 2. Reload Boot Code. 3. If problems persists, replace processor pcb.
"***Main Flash test FAILED.***" "***ERROR: The Main Code stored in flash is not valid.***"	1. Power cycle. 2. Reload Main Code. 3. If problems persists, replace processor pcb.
"***Main Code SDRAM FAILED.*** " "***ERROR: The region of SDRAM reserved for Main Code failed the memory test. Main Code will not be loaded unless this test passes. Reboot the monitor to repeat testing.***"	Replace processor pcb.
"***Static RAM test FAILED."*** "***ERROR: The SRAM memory test failed. Main Code will not be loaded unless this test passes. Reboot the monitor to repeat testing.***"	Replace processor pcb.

Message	Possible reason and solution
"Real Time Clock FAILED - will not start." ***"WARNING: The real time clock chip is not running. Main Code cannot be loaded until this chip is started. Attempting to start real time clock..."*** ***Followed by either*** ***"The real time clock was started. Select Start Patient Monitoring to load and execute Main Code."*** ***Or*** ***"ERROR: Unable to start the real time clock."***	If problem persists and error message displays, replace processor pcb.
"***EC1***" (displayed to the left of the ECG parameter block)	Perform all of the maintenance procedures listed in the "Manufacturer Recommendations" section of Chapter 4, Maintenance.
Service the PDM - Error Code	The Patient Data Module (PDM) has encountered a software, hardware or both a software and hardware error. Remove the PDM from the patient monitoring system immediately and send to service for repair. See the Patient Data Module service manual for troubleshooting information.

Reviewing error/event logs

This procedure describes how to review the error logs of a monitor or Tram module. The error logs may also be transferred over the network to a central station and copied onto diskette for further review or sent to GE personnel for review. The transferring procedure "Copying Error Log Files" is described later in this chapter.

WARNING
This procedure is intended for use by service personnel with advanced troubleshooting skills.

Accessing error/event logs

Some of the information recorded in the error logs is useful for field troubleshooting. The details included here serve as an introduction to the error logs and provide basic information about what you can learn from them.

1. Access ***REVIEW ERRORS*** starting from the ***MAIN*** menu. Select ***MORE MENUS*** -> ***MONITOR SETUP*** -> ***SERVICE MODE***.
2. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros (e.g., July 4 = 0407).
3. Select ***REVIEW ERRORS***.

The menu provides six error log choices, three for viewing error logs and three for clearing the error logs. It also provides two event log choices, one for viewing and one for clearing.

Error logs

1. Select ***VIEW SCOPE ERRORS*** to view one error in the log of errors.
2. The error log in a monitor holds 100 errors that can be accessed with the ***NEXT*** or ***PREVIOUS*** command. The errors display one error at a time in the upper right corner of the screen. Watch the error number category to keep track of which error you are viewing. If one error code seems significant, select ***PRINT***. The error code prints out at the central station determined by the monitor's graph destination menu.

   The ***VIEW TRAM ERRORS*** option provides a list of errors from the Tram module. It appears very similar to the monitor's listing.

   The VIEW INTERFACE ERRORS option provides a list of errors from the Unity Network ID connectivity device. It appears very similar to the monitor's listing.
3. To clear all the errors in the error log, select ***CLEAR SCOPE ERRORS***, ***CLEAR TRAM ERRORS***, or ***CLEAR INTERFACE ERRORS*** menu option. Be aware that once the clear menu option is executed, all selected errors in memory are erased.

Event log

The event log holds a record for each event the index, date, and time display. These are followed by the event code, event-specific data and a textual description of the event code.

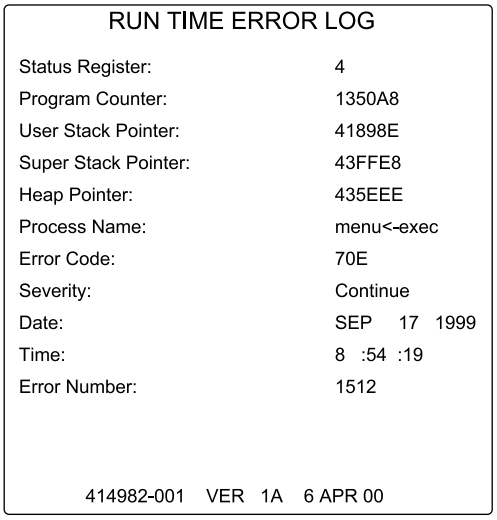
1. Select ***VIEW SCOPE EVENTS*** to scroll through the log of events.

   The event log holds 800 events that can be accessed by using the **TRIM KNOB** control. You may select ***PRINT*** to print out an event.

2. To clear all the events in the error log, select ***CLEAR SCOPE EVENTS*** menu option. Be aware that once the clear menu option is executed, all selected events in memory are erased.

Useful error data

Below is sample error log followed by a description of parameters found in the error log.



Definition of parameters	
Name	**Description**
Process Name	The name of the software task that was operating when the event or problem occurred.
Error Code	A code for the type of event/problem that occurred.
Severity	Indicates the impact of the event/problem on the system.
Date	The date the event or problem occurred.
Time	The time the event or problem occurred.
Error Number	A sequential number that is used to identify each event or problem.

For some categories of TRAM-NET network errors, two additional lines are added to the error log entry.

Definition of parameters	
Name	**Description**
Network Error	Identifies that a network error occurred.
Channel Number	Identifies the network channel exhibiting the error.

Severity is a measure of how the event/error affected the system. There are three levels of severity.

Definition of severity levels	
Levels	**Description**
Continue	The event or error was logged, the task may have or may not have been finished, but the system was able to go on. Most log entries will have a severity of ***CONTINUE***.
Fatal	The event or error was such that the task is not able to go on. Recovery was not possible. This always is followed by a *warm start.*
Forced Restart	The system was restarted by a known condition (internet address change, video test, etc).

What error codes mean

The error log contains more than just operating system errors. Many events that have an impact upon the system are also entered into the log. The 700-series of error codes are really system initiated events. Listed below are some of the event/error codes you might find useful.

Definition of parameters	
Error code	**Description**
400-4FF	Network errors were detected.
703	Diagnostic tests were completed.
70B	Internet address was changed. The network address for the monitor was changed. This should only be done by qualified service personnel.
70C	Video test was completed. This test should only be performed by qualified service personnel.
70D	Rear power switch was turned off.
70E	Time was changed from this monitor. This helps determine how the system-wide time may have been altered.
70F	Date was changed from this monitor. This helps determine how the system-wide date was altered.
710	Incompatible software was detected. If the main processor software finds that the software operating on the communication software is incompatible, it turns off the communication (network) controller and enters this data into the error log. If the monitor won't "talk" to the network, looking for this entry in the error log is one part of the troubleshooting process.
714	Incompatible TRAM module software was detected. If the main processor software finds the software revision in the TRAM is incompatible, it turns off communication with the TRAM and enters an error log. Refer to the software compatibility listing in the ***SOFTWARE REVISION*** window.
	SERVICE PATIENT DATA MODULE

NOTE

The monitor may be referred to as a display or scope in the error code descriptions.

Useful event data

The event log tracks alarm events and other changes to the system that can be useful in determining the state of the monitor if an error occurs. For each event, the event log records the event number, the date, the time, the event ID, the "bucket," and an event description. Additionally, an event description code is logged.

NOTE

"Bucket" data is information regarding the state of the event. For example, if the monitor's automatic alarm graphing is turned on or off, the event bucket will contain the number 0 or 1, which correspond to off and on.

The table below shows some common events, their event codes, the corresponding bucket data (if applicable) and other event data (if applicable). This data can be useful in interpreting the event log.

Event description	Event ID	Bucket data	Other event data
Alarm Graph On/Off Change	***800***	0 = Alarm graphing turned OFF 1 = Alarm graphing turned ON	
Graph Location Change	***801***	1 = Manual graph location changed 2 = Alarm graph location changed 3 = Print window location changed 4 = 12 lead print location changed	Text describing the graph name is shown.
Monitor Defaults Change	***802***		Text describing the default changed is shown (e.g., ***COLOR FORMAT***).
Alarm Limits Change PPtt	***803***	Limit is indicated in hex.	
Viewing Another Bedside On	***804***	1 = Split View 2 = Full View	Text describing the viewed bedside name is shown.
Viewing Another Bedside Off	***805***	1 = Split View 2 = Full View	Text describing the viewed bedside name is shown.
Network Connection Change	***806***	0 = Stops communicating 1 = Starts communicating	
TRAM/ECG Module Connection Change	***807***	0 = Stops communicating 1 = Starts communicating	

Get error logs

Get logs via PC using netUpdate

These instructions describe how to copy log files from a Solar 8000M/i patient monitor to a PC using one of the following configurations:

- PC or PC laptop connected to a Solar 8000M/i patient monitor
- PC or PC laptop connected to the Unity Network MC network.

CAUTION
LOSS OF MONITORING — There may be a temporary loss of monitoring functions until the log file retrieval is complete. Do *not* copy logs while a patient monitor is connected to a patient. Medical staff should be prepared to cover patients in need during these periods of lost monitoring functions.

Requirements

PC to patient monitor	PC to Unity Network MC network
■ One patient monitor software CD-ROM V5 or later. **NOTE** The netUpdate tool is only available on a software CD-ROM.	
■ Microsoft® Windows® XP, 2000 or NT™ operating system ■ CD-ROM drive ■ Network card	
Category 5 crossover patch cable (pn 415480-001)	Category 5 network patch cable (pn 408997-001)
NOTE ■ You must be able to change the IP address on the PC. ■ If you are using a PC laptop with a docking station, remove the laptop from the docking station before you begin the log transfer. ■ If you are using a PC with a wireless network connection, remove or disable the wireless network card before you begin the log transfer.	

Connect the PC to patient monitor or Unity Network MC network

1. Connect one end of the category 5 crossover or network patch cable to the PC network card.
2. Connect the other end of the category 5 crossover patch cable as follows:
   - Connect to the **ETHERNET** port of the patient monitor if no network is used.
   - Connect to the Unity Network MC network Ethernet tap if transferring logs from other devises on the network. If you connect directly to the Unity Network MC network Ethernet tap, verify that the patient monitor is also connected to the Unity Network MC network Ethernet tap.
3. Power on the PC.
4. Continue with the instructions, “Change the PC’s IP address” on page 29.

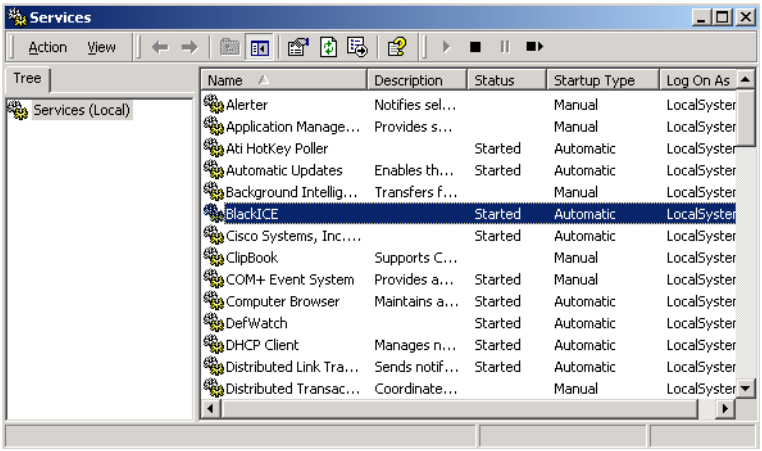
Change the PC's IP address

	Windows XP	Windows 2000
1.	From the toolbar, select ***Start*** > ***Run***.	
2.	Type **cmd** and press **Enter**.	
3.	Type **ipconfig<space>/all** and press **Enter**.	
4.	If the IP address and subnet mask are defined, record them: ■ IP address: _____ ■ Subnet mask: _____	
5.	From the toolbar, select ***Start*** > ***Control Panel*** > ***Network Connections***.	From the toolbar, select ***Start*** > ***Settings*** > ***Control Panel*** > ***Network and Dial-up Connections***.
6.	Right-click ***Local Area Connection***.	
7.	Select ***Properties***.	
8.	Select ***Internet Protocol (TCP/IP)***.	
9.	Click ***Properties***.	
10.	Select ***Use the following IP address***.	
11.	In the ***IP Address*** field, type an IP address. If the patient monitor's address begins with 126, use **126.003.145.229**. ■ If using a PC connected to the Unity Network MC network, the IP address on the PC must match the institution's Unity Network MC network domain. The network domain is defined by the first numbers used in the IP address and subnet mask. If the patient monitor's address does NOT begin with 126, contact the IT department for an IP address. ■ If using a PC connected to a patient monitor, and the IP address does not begin with 126, change the PC IP address to match the first 3 digits of the patient monitor's address. The remaining address must be unique.	
12.	In the ***Subnet mask*** field, type **255.0.0.0**.	
13.	In the ***Default gateway*** field, type **126.003.145.229** and click ***OK***.	
14.	If prompted to restart the PC, select ***No***.	
15.	From the toolbar, select ***Start*** > ***Control Panel***.	From the toolbar, select ***Start*** > ***Settings*** > ***Control Panel***.
16.	Double-click ***System*** and select the ***Computer Name*** tab.	Double-click ***System*** and select the ***Network Identification*** tab.
17.	Record the full computer name: _____	
18.	Close all open windows.	
19.	Restart the PC.	
20.	Continue with the instructions, "Disable firewall or networking services" on page 30.	

Disable firewall or networking services

If the PC is running a firewall protection or networking services, such as Cisco Systems VPN, BlackIce or a wireless network card, perform the following procedure to disable these services on the PC.

1. Select one of the following from the toolbar:
   - Windows XP: ***Start*** > ***Control Panel*** > ***Administrative Tools*** > ***Services***.
   - Windows 2000: ***Start*** > ***Settings*** > ***Control Panel*** > ***Administrative Tools*** > ***Services***.
2. In the list of available firewall/networking services, double-click the service (e.g. BlackICE) to be disabled.


Services
Action View
Tree
Services (Local)
Name Description Status Startup Type Log On As
Alerter Notifies sel... Manual LocalSyster
Application Manage... Provides s... Manual LocalSyster
Ati HotKey Poller Started Automatic LocalSyster
Automatic Updates Enables th... Started Automatic LocalSyster
Background Intellig... Transfers f... Manual LocalSyster
BlackICE Started Automatic LocalSyster
Cisco Systems, Inc.... Started Automatic LocalSyster
ClipBook Supports C... Manual LocalSyster
COM+ Event System Provides a... Started Manual LocalSyster
Computer Browser Maintains a... Started Automatic LocalSyster
DefWatch Started Automatic LocalSyster
DHCP Client Manages n... Started Automatic LocalSyster
Distributed Link Tra... Sends notif... Started Automatic LocalSyster
Distributed Transac... Coordinate... Manual LocalSyster

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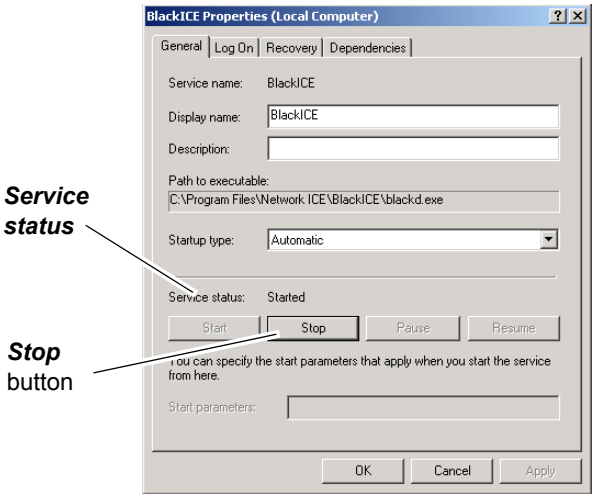
3. In the specific service (e.g. BlackICE) properties window, select ***Stop***.



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4. Verify that the ***Service status*** reads ***Stopped***.
5. Select ***OK*** and close all windows.
6. Repeat these instructions for all VPN, wireless network cards or any firewall protection programs running on your PC.

NOTE

If you are unsure of the firewall/networking services on your PC, contact your local IT administrator for details. Windows 2000 and XP PCs allow you to send a list of services to your IT administrator.

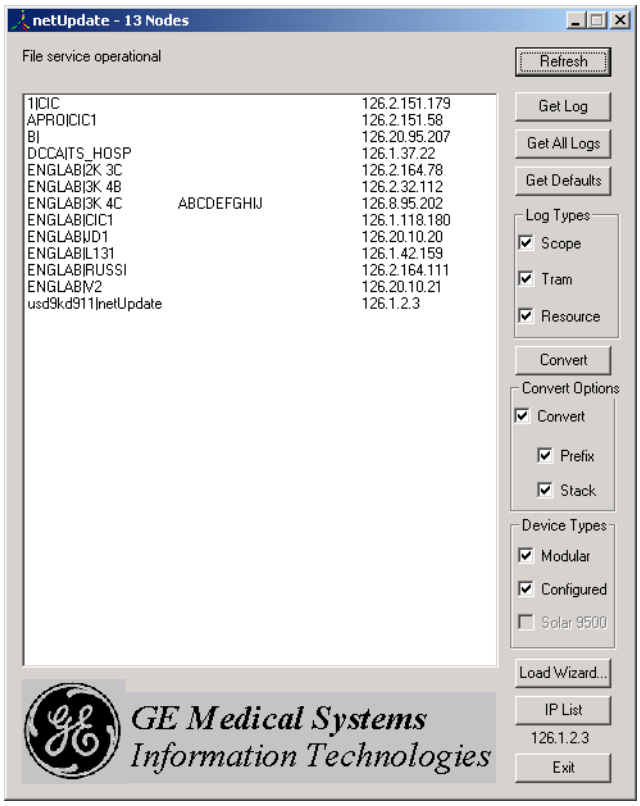
Set up a log folder and get logs

NOTE

Use the ***List*** or ***Details*** view on your PC when starting the ***netUpdate.exe*** application. Do not use the ***Thumbnail*** view.

Always run the ***netUpdate.exe*** application from the CD-ROM directory. Do not run the application from any other directory.

1. Make sure the patient monitor is in monitoring mode.
2. Insert the CD-ROM into the CD-ROM drive.
3. Double-click ***My Computer***.
4. Create a folder for the log files in the root directory. Filename can not have spaces. (e.g. ***C:\logs***)
5. Return to ***My Computer*** and double-click the CD-ROM drive.
6. Select ***dnld*** > ***code*** > ***netUpdate.exe***.



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7. In the ***netUpdate*** window, select the patient monitor name or IP address from the device list. Click ***Refresh*** until the IP address or patient monitor name displays.
8. Click ***Get Log*** or ***Get All Logs***.

NOTE

If you select ***Get All Logs*** and are connected to the Unity Network, logs from every device type selected will transfer.

9. Select the folder you created for log files, then click ***OK***.
10. The log file displays and a message at the top of the ***netUpdate*** window displays a message that the log retrieval was successful.

6 Configuration

Configuring a patient monitor

The following procedure explains how to configure a patient monitor on the Unity Network. The monitor communicates with central stations, and other related equipment over the Unity Network. This network is essentially an Ethernet implementation.

General

Use this procedure if you are:

- experiencing communication problems on the Unity Network, or
- adding a new monitor to the Unity Network.

Gather information

To configure a new monitor, you must first:

- know that the new monitor's software revision is compatible with the other monitors connected to the Unity Network.
- write down the exact care unit name from the upper left hand corner of the central station.
- write down the bed name for the new monitor.
- know if the monitor will be used for either stationary or ambulatory (telemetry) monitoring or both.
- know if the monitor will be moved from one Ethernet connection to another.

Select procedures

Choose and program the procedures listed below in the order presented. Each procedure is described on the next pages.

- Set Unit Name (Main Code)
- Set Bed Number (Main Code)
- Patient-Monitor Type (Main Code)
- Set Graph Locations
- Admit Menu (Main Code)
- Set Line Frequency (optional, Boot Code)
- Set Defib Sync Voltage and Pulse Width (optional, Boot Code)
- Set Country Selection (Boot Code)
- Set Language (Boot Code)
- Calibrate Touchscreen

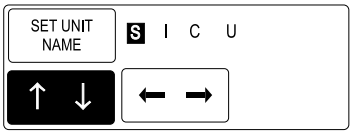
After completing all necessary procedures, perform the "Checkout procedure" on page 4-16.

Set unit name

Up to seven characters are used to identify the care unit. These characters display at the top right of the screen immediately preceding the bed number.

Access ***SET UNIT NAME*** option, starting from the ***MAIN*** menu.

1. Select ***MORE MENUS*** > ***MONITOR SETUP*** > ***SERVICE MODE***.
2. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros (e.g., July 4 = 0407).
3. Select ***MONITOR SETTINGS*** > ***SET UNIT NAME***.



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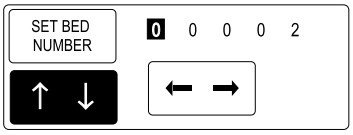
4. Use the **TRIM KNOB** control to select and change each character. Up to seven characters may be entered.
5. Select ***SET UNIT NAME*** and press the **TRIM KNOB** control to exit.

Set bed number

The bed number identifies a particular patient bed. Up to five characters are used to identify bed number. This number displays at the top right of the screen.

Access ***SET BED NUMBER*** option, starting from the ***MAIN*** menu.

1. Select ***MORE MENUS*** > ***MONITOR SETUP*** > ***SERVICE MODE***.
2. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros (e.g., July 4 = 0407).
3. Select ***MONITOR SETTINGS*** > ***SET BED NUMBER***.



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4. Use the **TRIM KNOB** control to select and change each character. Up to five characters may be entered.
5. Select ***SET BED NUMBER*** and press the **TRIM KNOB** control to exit.

Patient monitor type

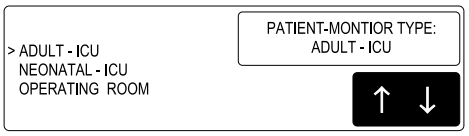
The ***PATIENT-MONITOR TYPE*** selection determines the type of monitor desired, i.e., adult, neonatal or operating room. Different alarms and parameters are activated for each selection. This menu item is part of the ***SERVICE MODE*** menu.

CAUTION
Each time the patient-monitor type is changed, the ***ADMIT MENU*** function defaults to ***STANDARD*** configuration. Be aware that some alarms and parameters may be changed.

NOTE
The keypad or remote control is DIDCA programmed for specific monitor types. The error message ***WARNING: REMOTE MISMATCHED WITH MONITORING MODE*** displays if the monitor and keypad/remote control do not match.

Access ***PATIENT-MONITOR TYPE*** option, starting from the ***MAIN*** menu.

1. Select ***MORE MENUS*** > ***MONITOR SETUP*** > ***SERVICE MODE***.
2. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros (e.g., July 4 = 0407).
3. Select ***PATIENT-MONITOR TYPE***. Be sure to read the information in the ***ATTENTION*** box before changing anything.



4. Rotate **TRIM KNOB** control to select the type of environment the monitor will be used in.
5. Press **TRIM KNOB** control to exit. Your selection displays at the top of the screen after the time.

Set graph locations

Access ***MANUAL GRAPH LOCATION*** option, starting from the ***MAIN*** menu.

1. Select ***MORE MENUS*** > ***MONITOR SETUP*** > ***GRAPH SETUP*** > ***GRAPH LOCATION*** > ***MANUAL GRAPH LOCATION***.
2. Using the **TRIM KNOB** control, choose the manual graph location from the list.
3. Select ***ALARM GRAPH LOCATION***.
4. Using the **TRIM KNOB** control, choose the alarm graph location from the list.
5. Select ***PRINT WINDOW LOCATION***.
6. Using the **TRIM KNOB** control, choose the print window location from the list.
7. Select ***12 LEAD PRINT LOCATION***.
8. Using the **TRIM KNOB** control, choose the 12 lead print location from the list.

Communication confirmation

Confirm communication across the network.

1. Admit and generate a waveform at the monitor with a simulator.
2. Press **Graph Go/Stop** and observe graph output at chosen locations.

Problems?

If the writer or printer does not graph:

- Ensure the writer or printer is turned on.
- Check all cables for a good connection.
- Check programmed alarms and manual graph locations at the monitor.

If you do not have a waveform at the central station:

- Ensure the central station software is compatible.
- Check all cables for a good connection.
- Check the programmed alarms and manual graph locations at the monitor.
- Ensure the care unit name is the same in the monitor and in the central station.
- Ensure the central station serial number and LAN address are programmed correctly.

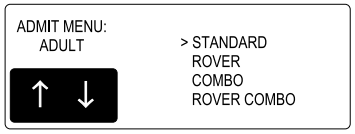
Admit Menu

The ***ADMIT MENU*** selection determines the function of the monitor. This menu item is part of the ***SERVICE MODE*** menu.

Before programming the ***ADMIT MENU***, you must know if the monitor will be used for standard adult, neonatal, or operating room monitoring, and if the monitor will be moved from room to room. All combinations are explained below.

- ***STANDARD*** configures the monitor to stay in one room for stationary monitoring only. Monitors not connected to the Unity network (Ethernet connection) must use ***STANDARD*** configuration only.
- ***ROVER*** configures the monitor to move from room to room for stationary monitoring only.
- ***COMBO*** configures the monitor to stay in one room for both stationary and ambulatory (telemetry) monitoring. This monitor displays all Tram module data combined with ECG data for ambulatory patients.
- ***ROVER COMBO*** configures the monitor to move from room to room for both stationary and ambulatory (telemetry) monitoring.

1. Access ***ADMIT MENU*** option, starting from the ***MAIN*** menu. Select ***MORE MENUS > MONITOR SETUP > SERVICE MODE***.
2. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros (e.g., July 4 = 0407).
3. Select ***MENU SETUP > ADMIT MENU***.



4. Use the **TRIM KNOB** control to select the function of the monitor.
5. Press **TRIM KNOB** control to exit.

Set line frequency

Use the Boot Code ***SERVICE MENU*** to configure or change the monitor line frequency to 50 or 60 Hz. The default is 60 Hz.

Activate the Boot Code:

1. Hold down **NBP Go/Stop** and **Zero All**.
2. Press and release the **TRIM KNOB** control.
3. Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display.
4. Select ***4 SET CONFIGURATION*** menu option.
5. In the ***Configuration Menu***, select ***Line Frequency*** then choose ***50 Hz*** or ***60 Hz*** line frequency.

Set defib sync voltage and pulse width

The Solar 8000M/i patient monitor controls the analog out signal used to trigger a defibrillator. Refer to the defibrillator manufacturer's manual for the required pulse amplitude and duration.

Use the Boot Code ***SERVICE MENU*** to configure or change the ***MARKER OUT*** signal of the ***DEFIB SYNC*** connector on a Solar ECG module.

Activate the Boot Code:

1. Hold down **NBP Go/Stop** and **Zero All**.
2. Press and release the **TRIM KNOB** control.
3. Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display.
4. Select ***SERVICE MENU***.
5. Select ***4 SET CONFIGURATION*** menu option.
6. In the ***Configuration Menu***, select:
   - ***1 Defib Sync Voltage:*** and choose ***5V*** or ***12V*** amplitude.
   - ***2 Defib Sync Pulse Width:*** and choose ***10 ms*** or ***100 ms*** for pulse duration.

Set country selection

Select ***DEFAULT, FRANCE***, or ***GERMANY*** to choose a particular set of GE factory defaults.

Activate the Boot Code:

1. Hold down **NBP Go/Stop** and **Zero All**.
2. Press and release the **TRIM KNOB** control.
3. Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display.
4. Select ***4 SET CONFIGURATION*** menu option.
5. In the ***Configuration Menu***, select ***4 Country Selection*** and choose the desired set of factory defaults.

Set language

Follow the steps for Set Country Selection above, except in the ***Configuration Menu***, select ***5 Set Language*** and select the desired language.

WARNING
Changing the language will discharge the monitor and erase any saved monitor defaults. The monitor defaults will be set to the factory defaults.

Calibrate touchscreen

Access the ***CALIBRATE TOUCHSCREEN*** option, starting from the ***MAIN*** menu.

1. Select ***MORE MENUS*** > ***MONITOR SETUP*** > ***SERVICE MODE***.
2. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros (e.g., July 4 = 0407).
3. Select ***CALIBRATE***.
4. Select ***CALIBRATE TOUCHSCREEN***.
5. Touch and hold each of the 4 Xs as they appear per on-screen instructions.

Completion

The monitor is now ready for normal operation. At this time, perform the "Checkout Procedure" found in Chapter 3, Maintenance.

Advanced user procedures

The following procedures are for advanced users only. These procedures should rarely be used, and only experienced technicians should proceed.

Procedures

The following procedures are discussed in this chapter.

- Set Time and Date
- Change Software Level
- Transfer Monitor Defaults
- Change Ethernet Address
- Set Internet Address
- Reviewing Error/Event Logs
- Transferring Error Logs

After completing any of the procedures, it is recommended to perform the "Checkout Procedure" found in Chapter 3, Maintenance.

Set time and date

Change the time only when the system is switched to or from daylight savings time.

NOTE

When a monitor is first connected to the Unity Network, the time and date is automatically updated from the network time.

WARNING

Loss of patient data history. Changing the time or date settings may result in the loss of patient data history. If one monitor's time or date is changed, all monitors on the network 'listen' and follow suit within 3-5 seconds. Changing the time base of one monitor may cause some loss of patient data history for all the monitors on the network.

The following procedure explains how to use the ***TIME AND DATE*** option in the monitor ***SERVICE MODE*** menu.

1. Access the ***TIME AND DATE*** menu starting from the ***MAIN*** menu. Select ***MORE MENUS*** > ***MONITOR SETUP*** > ***SERVICE MODE***.
2. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros (e.g., July 4 = 0407).
3. To set the time, select ***SET TIME*** and use the **TRIM KNOB** control to change the time. The time displays as a 24-hour military clock.
4. To set the date, select ***SET DATE*** and use the **TRIM KNOB** control to change the date.

Change software level

If you want to change the software to a higher level or add software options, it must be done in Boot Code using a unique password.

Fax a password request to GE Customer Relationship Center at (414) 362-3250 to obtain a password. You must provide your product serial number and Ethernet address. (The Ethernet address displays in the Boot Code banner information.)

Activate the Boot Code program as follows:

1. Hold down **NBP Go/Stop** and **Zero All** on the keypad or remote control.
2. Press and release the **TRIM KNOB** control.
3. Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display.
4. Select ***Option Menu*** > ***Change Software Level***.

Enable options

For information about enabling software options see, "Service menu (boot code)" on page 5-3.

Transfer monitor defaults

The monitor defaults set on one monitor may be transferred to another monitor, provided that the second monitor shares the following:

- the same software revision (version),
- the same patient-monitor type (i.e., ***ADULT***, ***NEO***, or ***OR***),
- the same software package (i.e., ***Basic*** or ***Cardiac***), and
- the same country code (i.e. ***DEFAULT***, ***FRANCE***, or ***GERMANY***).

The following defaults transfer when using this feature:

- all monitor defaults
- custom default names
- 12 SL location
- 12 SL site

Store monitor defaults for transfer

To transfer monitor defaults, they must be set, then stored on the monitor that is used as the server.

1. At the server monitor, set up the monitor defaults you want to store. (Refer to Monitor Setup in the Solar 8000i Operator's Manual.)
2. When defaults are set, start from the MAIN menu and select ***MORE MENUS*** > ***MONITOR SETUP*** > ***SERVICE MODE***.
3. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros (e.g., July 4 = 0407).
4. Select ***MONITOR SETTINGS***.
5. Select ***STORE DEFAULTS FOR NETWORK TRANSFER***.
6. Selects ***YES*** to the confirmation popup menu.

Copy stored monitor defaults

WARNING
Loss of Defaults. Copying monitor defaults from another monitor erases all of the monitor defaults on the current monitor.

To copy monitor defaults from the server monitor, the client monitor must be in the ***DISCHARGED*** state. If the client monitor is set to the ***OR*** patient-monitor type, it must not be in ***COMBO*** or ***ROVER COMBO*** admit mode.

NOTE
Make sure that the client monitor shares the same configuration as the server monitor.

1. At the client monitor, start from the ***MAIN*** menu and select ***MORE MENUS*** > ***MONITOR SETUP*** > ***SERVICE MODE***.
2. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros (e.g., July 4 = 0407).
3. Select ***COPY UNIT DEFAULTS***.
4. Select ***SELECT UNIT TO COPY MONITOR DEFAULTS FROM***.
5. From the list of units on the Unity Network, choose the server monitor.
6. Select ***SELECT BED TO COPY MONITOR DEFAULTS FROM***.
7. Scroll through the list of beds within the selected unit until the desired bed is found. Select it, and answer ***YES*** to the confirmation popup menu.

NOTE
After transferring monitor defaults, the first set of defaults is automatically activated. If another set of defaults is desired, the user must manually select it from the ***RECALL DEFAULTS*** menu.

After copying monitor defaults from another bed (the server monitor), verify that the defaults were transferred and arrhythmia levels are as desired.

Troubleshooting monitor defaults transfer

Below is a list of error messages that may display when performing a monitor default transfer.

Storing monitor defaults

Message	Description
ERROR - UNIT DEFAULTS HAVE NOT BEEN SAVED	Monitor defaults were not saved due to a memory error in the monitor.

Copying stored monitor defaults

Message	Description
ERROR COPYING UNIT DEFAULTS - NETWORK ERROR	Either an error has occurred while the defaults were being transferred, or defaults have not been saved on the server monitor.
ERROR COPYING UNIT DEFAULTS - UNIT TYPE MISMATCH	The server and client monitors are set to different unit types (i.e., ***ADULT***, ***NEO***, or ***OR***)
ERROR COPYING UNIT DEFAULTS - SOFTWARE VERSION MISMATCH	The server and client monitors have either different revisions of software, or different software versions (i.e., Solar 7/8000 vs. Solar 8000i)
ERROR COPYING UNIT DEFAULTS - DATA CORRUPTION ERROR	The monitor defaults transferred have become corrupted, possibly due to a memory error.
ERROR COPYING UNIT DEFAULTS - SOFTWARE FEATURE MISMATCH	The server and client monitors are set to different software levels (i.e., Basic, Cardiac).
ERROR COPYING UNIT DEFAULTS - COUNTRY CODE MISMATCH	The server and client monitors are set to different country codes (i.e., ***DEFAULT***, ***FRANCE***, or ***GERMANY***).

Change Ethernet address

The Ethernet address is an identification number assigned to each device on the Unity Network. It must be done in Boot Code using a unique password only if it has been corrupted.

WARNING
Lost Data. Duplication of an Ethernet address on a network will cause lost data. If you change the factory assigned Ethernet address, you must first record all *other* Ethernet addresses used on your network to avoid duplication.

Fax a password request to GE Customer Relationship Center at 877-633-8181 to obtain a password. You must provide your product serial number and Ethernet address. (The Ethernet address displays in the Boot Code banner information.)

Activate the Boot Code program as follows:

1. Hold down **NBP Go/Stop** and **Zero All** on the keypad or remote control.
2. Press and release the **TRIM KNOB** control.
3. Keep holding **NBP Go/Stop** and **Zero All** until the Boot Code information appears on the display.
4. Select ***Option Menu*** > ***Change Ethernet Address***.

Set internet address

The internet (IP) address is generated to connect Unity devices for the exchange of patient data and room-to-room communication. It may be manually derived from the monitor Ethernet address in this procedure if the factory-assigned internet address is corrupted.

NOTE

GE highly recommends using a 'private' LAN to connect Unity products. The purpose of the Unity Network is to connect only Unity devices for the exchange of patient data and room-to-room communication. Adding non-Unity devices (PCs, laptops, desktops, etc.) may compromise the ability of the Unity Network to meet its intended use.

A 'private' LAN is not the same as a private IP address.

WARNING

Lost Data. Duplication of an internet (IP) address on a network will cause lost data. If you change the factory assigned internet address, you must first record all *other* internet addresses used on your network to avoid duplication.

Valid and invalid IP addresses

Class A, Class B and Class C IP addresses are valid. Class D and Class E are invalid.

Class A =	0-127.x.x.x	OK
Class B =	128-191.x.x.x	OK
Class C =	192-233.x.x.x	OK
Class D =	234-239.x.x.x	Invalid
Class E =	240-255.x.x.x	Invalid

If using a Class A address, then all other octets (.x) can be any value.

If using a Class B address then all monitors that need to communicate with each other must have the same first *two* octets. For example:

130.1.1.2	OK
130.1.3.4	OK
130.1.5.6	OK
130.2.7.8	won't see other beds

If using a Class C address then all monitors that need to communicate with each other must have the same first *three* octets. For example:

192.1.2.1	OK
192.1.2.2	OK
192.1.2.3	OK
192.2.2.4	won't see other beds

Calculate internet address

To generate an internet address from an Ethernet address, GE simply converts the last three bytes of the Ethernet address from hex to decimal. This combines the unique identifier along with the network ID to produce the entire internet address.

Calculate the factory-assigned internet (IP) address as follows.

1. Write down the LAST SIX digits of the 12-digit monitor Ethernet address. (The Ethernet address displays in the Boot Code banner information.) An example is given below.

   00 : 00 : 7E : 26 : 13 : FD

2. Consider the six digits as three separate hexadecimal pairs. Convert each hexadecimal pair separately to a decimal number. All internet addresses must be in decimal.
3. The first number of the internet address is always 126 (decimal). The low three hex pairs of the IP address are the low three Ethernet address hex pairs converted to decimal.

   126 . 38 . 19 . 253

Enter internet address

Use the monitor ***SERVICE MODE*** menu in ***Main Code***.

1. Access the ***SET INTERNET ADDRESS*** option starting from the ***MAIN*** menu. Select ***MORE MENUS*** > ***MONITOR SETUP*** > ***SERVICE MODE***.
2. Enter password using the **TRIM KNOB** control to select the day and month from monitor screen with leading zeros (e.g., July 4 = 0407).
3. Select ***MONITOR SETTINGS***-> ***SET INTERNET ADDRESS***.
4. Use the **TRIM KNOB** control to enter the correct digits.
5. Press the **TRIM KNOB** control to exit.

Power cycle

Power cycle the monitor by turning the rear power switch off and then on. This configures the monitor with the new programmed data.

7 Field replaceable units

Ordering parts

The parts lists and assembly drawings in this chapter supply enough detail for you to order parts for the assemblies considered field serviceable. If you require additional information or troubleshooting assistance, contact Technical Support.

To order parts, contact Service Parts at the address or telephone number listed on the “How to Reach Us...” page found in the front of this manual.

For the latest parts information, including substitutions, obsolescence and compatibility, please visit our Parts ID Portal website at: http://egems.gehealthcare.com/partsiduser/gems/Welcome.jsp

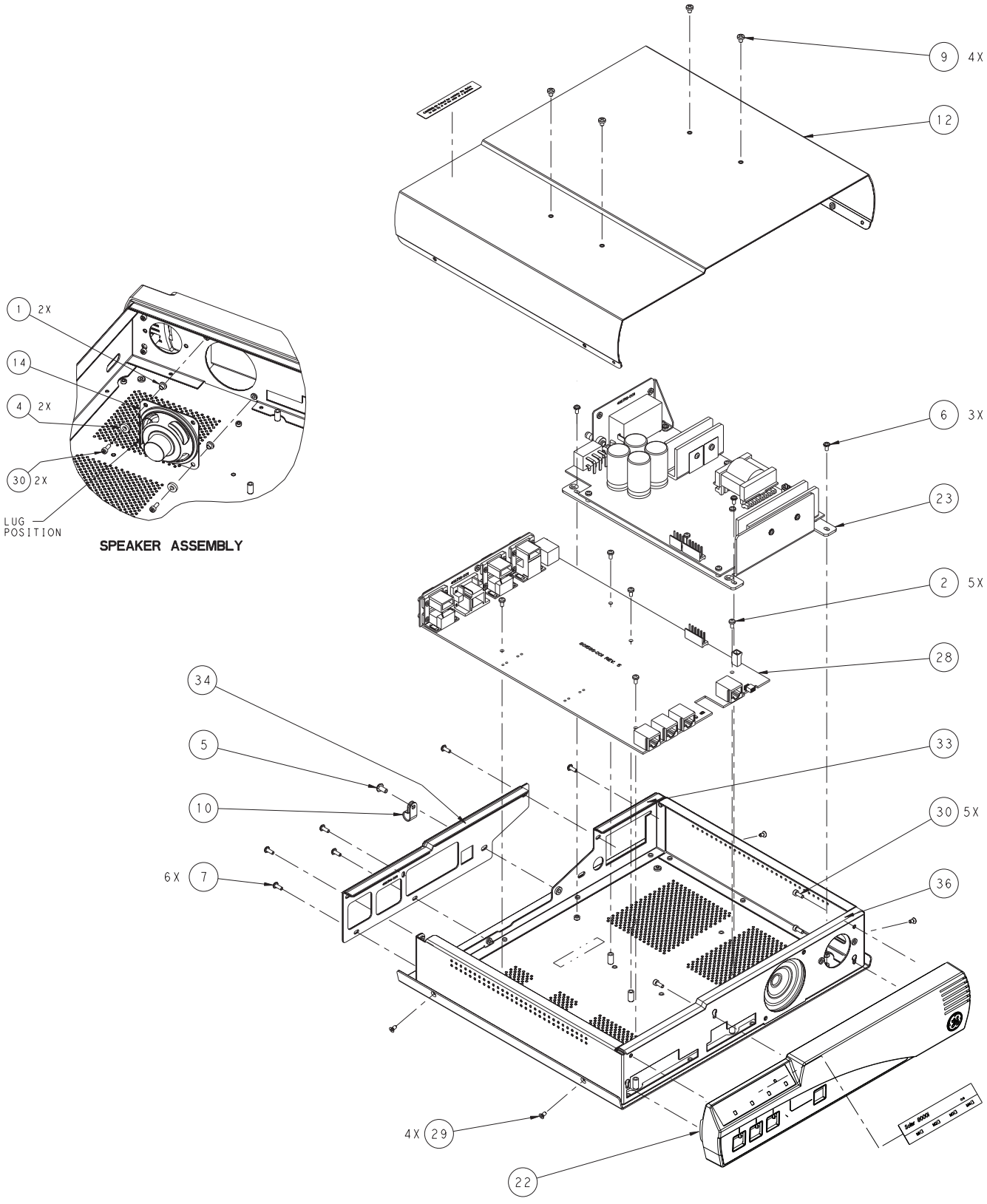
Field replaceable units

The table below lists the replaceable assemblies that can be ordered.

Field replaceable units		
Find number	**Item**	**Part number**
14	Speaker Assembly	421378-003
12	Top Cover	418715-003
22	Bezel Assembly ■ Solar 8000i ■ Solar 8000M	 2026943-007 422810-004
23	Power Supply Assembly	801674-001
28	Processor FRU kit includes: ■ PCB assembly ■ Solar 8000M rear label ■ Solar 8000i rear label ■ Hardware kit (See "Hardware kit" on page 7-4.) Note: The processor pcb is dual video and has dual function TRAMNET/e-Port connection. It is compatible with all previous hardware configurations of Solar 8000M/i but requires software version 5.1	2026943-008
-	Wire Harness (Processor to Power Supply)	422812-002
-	AutoPort to M-Port Adapter	2001973-001
-	Remote Control Holder Kit (includes holder and mounting materials)	2013770-002
-	Remote Keypad Holster with Flat Panel Display Mount	2001244-003

Hardware kit

Find number	Item description	Qty
1	WASHER SHOULDER NYLON .1401	2
2	SCREW PH M3 X 8MM	5
4	SPACER Q3 NYLON	2
5	SCREW SEMS M4- .7X10	1
6	SCREW SEMS PH M3 X 6MM	3
7	SCREW SEMS PH M3- .5X8	6
9	SCR SL BDGH 6-32 X 3/16 NYLON	4
10	CLAMP CABLE	1
29	SCR MACH FLHD M3 X 6MM SS N8.25 GRAY	4
30	SCR DIN912 M3 X 8MM ZINC VIBRA	7
33	GASKET EMI SHIELD FOAM NA-C2 E67 3.3	1
34	GASKET EMI SHIELD FOAM NA-C2 E67 9.5	1
36	GASKET EMI SHIELD FOAM NA-C2 E67 12.8	1


9 4X
12
1 2X
14
4 2X
30 2X
LUG POSITION
SPEAKER ASSEMBLY
6 3X
23
2 5X
28
34
5
10
6X 7
33
30 5X
36
4X 29
22

Keypads and remote controls

Description	Item number
Keypad Adult with Label Kit	2026967-001
Keypad OR with Label Kit	2026967-002
Keypad NEO with Label Kit	2026967-003
Remote Adult with Label Kit	2026967-004
Remote OR with Label Kit	2026967-005
Remote NEO with Label Kit	2026967-006

Cables

Description	Item number
5 Foot Cable	420857-001
10 Foot Cable	420857-002
20 Foot Cable	420857-003
50 Foot Cable	420857-004
100 Foot Cable	420857-xxx

Description	Item number
6 Foot Serial Cable for touchscreen interface	2006733-001
10 Foot Serial Cable for touchscreen interface	2006733-002
15 Foot Serial Cable for touchscreen interface	2006733-003
25 Foot Serial Cable for touchscreen interface	2006733-004

Description	Item number
6 Foot Serial Cable for iPanel interface	2000727-001
10 Foot Serial Cable for iPanel interface	2000727-002
15 Foot Serial Cable for iPanel interface	2000727-003
25 Foot Serial Cable for iPanel interface	2000727-004

Disassembly

Guidelines

Follow these guidelines when disassembling the monitor. You will need a standard set of hand tools including a #1 Phillips head screwdriver.

WARNING
Repair to the FRU level. Field repairs are recommended to the field replaceable unit (FRU) only. Attempting a field repair on a pcb or a factory sealed component or assembly could jeopardize the safe and effective operation of the patient monitor.

Electrostatic discharge (ESD) precautions

All external connectors of the Solar 8000M/i patient monitor are designed with protection from ESD damage. However if the module requires service, exposed components and assemblies inside are susceptible to ESD damage. This includes human hands, non-ESD protected work stations or improperly grounded test equipment.

The following guidelines may not guaranty a 100% static-free workstation, but can greatly reduce the potential for failure of any electronic assemblies being serviced:

- Discharge any static charge you may have built up before handling semiconductors or assemblies containing semiconductors.
- A grounded, antistatic wristband (3M part number 2046 or equivalent) or heel strap should be worn at all times while handling or repairing assemblies containing semiconductors.
- Use properly grounded soldering and test equipment.
- Use a static-free work surface (3M part number 8210 or equivalent) while handling or working on assemblies containing semiconductors.
- *Do not* remove semiconductors or assemblies containing semiconductors from antistatic containers (Velo-stat bags) until absolutely necessary.
- Make sure power to an assembly is turned off before removing or inserting a semiconductor.
- *Do not* slide semiconductors or electrical/electronic assemblies across any surface.
- *Do not* touch semiconductor leads unless absolutely necessary.
- Semiconductors and electronic assemblies should be stored only in antistatic bags or boxes.
- Handle all PCB assemblies by their edges.
- *Do not* flex or twist a circuit board.

Hardware

- Before disassembly, note the positions of any wires or looms (cables), marking them if necessary to ensure that they are replaced correctly.
- Gray ribbon cables have retainer clips holding them in the connector.
- Save and set aside all hardware for reassembly.

Disassembly procedures

WARNING
Patient monitoring interruption. Make sure a patient is not being monitored.

First, turn the unit off at the rear power switch and disconnect the AC power cord and all communication cables.

WARNING
Due to possible high voltage present, use an insulated screwdriver at all times.

Refer to the exploded view of the unit in this chapter when disassembling. Reassemble the unit in reverse order of disassembly unless otherwise stated.

WARNING
Shock hazard. High voltages exist in this unit. Use insulated tools. Remove jewelry. Use only one hand when possible.

Cover

1. Remove four painted screws on the sides of the unit.

   NOTE
   Use the #1 Phillips head screwdriver.

2. Slide the cover directly back toward the rear to clear the right angle piece of the M-port ethernet cable, then lift cover off.

Power supply

1. Remove cover.
2. Disconnect cable harness between circuit boards.
3. Remove three screws that secure the aluminum mounting bracket to the chassis.
4. At the top rear of the unit, remove the two screws closest to the AC power inlet.
5. Slide the power supply forward to clear the equipotential post and lift out the power supply.

Processor PCB

Before replacing the processor pcb

Before replacing the processor pcb, write down the following information: (All settings are viewable in Boot Code except for unit type. See "Boot loader or boot code" on page 5-2.)

- Current language (set in Boot Code)
- Bed number (set in Main Code)
- Unit name (set in Main Code)
- Subnet masks 1 and 2 (set in Boot Code)
- Gateway addresses 1 and 2 (set in Boot Code)
- Internet (IP) addresses 1 and 2 (set in Boot Code)
- Product type (Unity View or Solar 8000M/i) (set in Boot Code)
- Line frequency (50/60 Hz) (set in Boot Code)
- Sync pulse height and width (set in Boot Code)
- Hi Res trends (enabled/disabled) (set in Boot Code)
- Software feature level (set in Boot Code)
- Country selection (set in Boot Code)
- Unit type (adult, OR, neonatal) (set in Main Code)

Replace the processor pcb

1. Remove the cover. (See "Cover" on page 7-8.)

   If your unit has a Solar 8000M/i patient monitor to Patient Data Module (SPA), then:

   a. Remove 2 screws from the SPA.

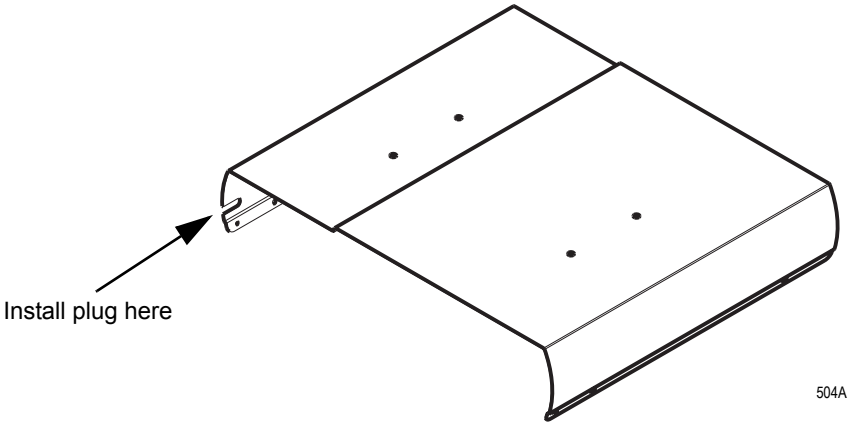
   b. Disconnect the SPA from the TRAMNET 1 port.

   c. Remove the M-Port ethernet cable from the SPA and the M-Port.

   NOTE

   The above items are no longer needed with the new processor pcb.

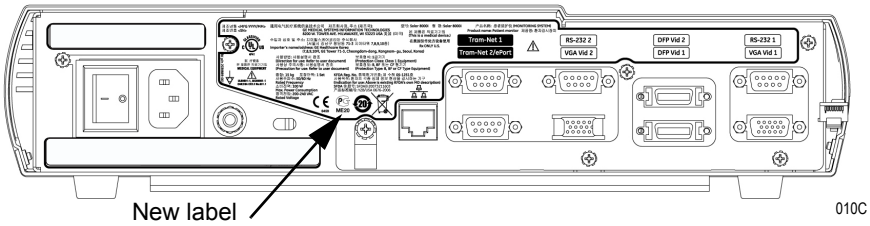
d. Install the plug in cover.



2. Remove six screws holding the rear panel. Remove the rear panel. (The processor board cannot be removed without first removing rear panel.)
3. Remove cable harness to the power supply.
4. Remove five screws holding the board to the chassis.
5. Disconnect speaker cable.
6. Slide the board toward rear to clear front of chassis.

After replacing the processor pcb

1. Clean or remove the old label and apply the new label from the FRU kit.



2. Perform a cold start. (See "Cold start" on page 5-2.)

   Visually verify that the "***performing cold start***" message appears to be sure the a cold start was actually performed.

3. Restore the above settings.
4. If the patient monitor is *not* on the Unity Network, be sure to set the time and date.

> **WARNING**
> Patient data loss. Do not change the time and date if the patient monitor is on a network. Doing so will result in patient data loss.

   If the monitor is on a network, verify that the time and date is automatically set by the network time master.

Lithium battery

The following error message will appear when the lithium battery fails.

ERROR: THE INTERNAL BATTERY THAT MAINTAINS THE MONITOR'S DEFAULTS HAS FAILED!"
**** * SERVICE MAY BE REQUIRED * ****

When this error message appears, complete the steps listed above for the processor board. Then desolder the battery and solder in a new lithium battery.

Speaker

1. Remove the cover.
2. Using a metric hex or allen wrench with ball end, unscrew two screws.
3. Remove speaker from chassis.

A Appendix A – Technical specifications

Solar 8000M/i patient monitor

Due to continual product innovation, specifications and standards are subject to change without notice. The following specifications are accurate as of the date of this publication, and pertain to Solar 8000M/i patient monitor.

Specifications are based on a complete system including a 15 inch monitor (display*).

Performance specifications

Solar 8000M/i processing unit controls

Optional keypad with Trim Knob control and 18 active hard keys. See Keypad for applications and specifications.

Optional remote control with Trim Knob control and 18 active hard keys. See Remote Control for applications and specifications.

Optional touchscreen interface:	Requires touchscreen display and software.
Communications protocols:	
TRAM-NET	Proprietary CSMA/CD protocol at 921 Kbits/sec
Unity	Ethernet IEEE 802.3 10 BASE T LAN

Processing

Main processor:	Motorola® MPC860P (PowerPC), 66 MHz, 32 bit
Graphics processor:	Silicon MotionGraphics Accelerator with Silicon Image Transmitter providing images on VGA and DFP displays
TRAM-NET communication processor:	Within Motorola MPC860P (PowerPC), 66 MHz, 32 bit
LAN communication processor:	Within Motorola MPC860P (PowerPC), 66 MHz, 32 bit

Alarms

Classification:	
Patient Status Alarms — 4 levels:	Crisis, Warning, Advisory, and Message
System Status Alarms — 2 levels:	Warning and Advisory
Notification:	Audible and visual, dependent on alarm level
Display of alarm information:	All limits are viewable and printable
Continuous display of limits:	All parameters, one set of limits

Interfaces

Contact your local sales representative.

Environmental specifications

Power requirements:	110 ±20 VAC, 50/60 Hz, single phase 230 ±40 VAC, 50/60 Hz, single phase
Power consumption:	100 Watts
Low-voltage shutdown:	<90 VAC/<190 VAC
Cooling:	Natural convection
Heat dissipation:	341 Btu/hr

Operating conditions

Ambient temperature:	0°C to 40°C (32°F to 104°F)
Relative humidity:	15% to 95% (noncondensing)

Storage conditions

Temperature:	-40°C to 70°C (-40°F to 158°F)
Relative humidity:	15% to 95% (noncondensing)

Physical specifications

Height:	8.1 cm (3.2 in)
Width:	35.4 cm (13.9 in)
Depth:	33.4 cm (13.2 in)
Weight:	5.6 kg (12.3 lb)

Warranty

Standard warranty is one year. Other options are available.

Display* The display is ordered separately from the Solar 8000M/i processing unit.

Display size:	15” to 19” typical
Display types:	Analog and digital flat panel, CRT displays
Display resolution:	1024 x 768
Sweep speed:	25 mm/sec typical (user has ability to vary speeds of individual traces)
Aspect ratio:	4 to 3 (fixed, not user-adjustable)
Touch screen:	Utilizes ELO graphics and surface acoustic wave technology
Frequency response:	Limited by input response of data acquisition device
Number of traces:	1 to 8
Number of seconds/trace:	6.5 seconds typical (can differ if user varies speeds of individual traces)
Waveform display options:	Full, individual, or CRG+ Options
Information window:	Displays non-realtime information without obstructing the display of real-time patient information.
Display organization:	Prioritized by parameter

Display gain and sweep speeds:

Display size:	Gain[1]:	Sweep speed[2]:
15”	13 mm/mv	34 mm/s
19”	17.5 mm/mV	43 mm/s

[1]ECG size at 1X

[2]ECG waveform speed at 25 mm/s

Standards compliance

Due to continual product innovation and standards changes, compliance to applicable standards is subject to change. The following are accurate as of the date of this publication. For additional information, contact your local GE representative.

Solar 8000M/i with Patient Data Module:	IEC/EN/UL 60601-1 CAN/CSA C22.2 No. 601.1 IEC/EN 60601-1-2, IEC/EN 60601-1-4, IEC/EN 60601-2-27, IEC/EN 60601-2-30, IEC/EN 60601-2-34, IEC/EN 60601-2-49, IEC/EN 60601-2-51 EN 12470-4 ISO 9919 ANSI/AAMI SP10, ANSI/AAMI EC13, ANSI/AAMI EC11 CE Marking: Medical Device Directive - 93/42/EEC JJG 760-2003, YY 91079-1999
Solar 8000M/i with Tram module and discrete modules:	IEC/EN/UL 60601-1 CAN/CSA C22.2 No. 601.1 IEC/EN 60601-1-2, IEC/EN 60601-1-4, IEC/EN 60601-2-23, IEC/EN 60601-2-27, IEC/EN 60601-2-30, IEC/EN 60601-2-34, IEC/EN 60601-2-49 EN ISO 21647 (CO2 Mainstream module) ANSI/AAMI SP10, ANSI/AAMI EC13 CE Marking: Medical Device Directive 93/42/EEC

Tram-rac 2 and 4A module housings

Processing

Data acquisition:	Intel 80C31, 8 bit, 14.7 MHz
Display communication:	Intel 80C152, 8 bit, 14.7 MHz
Communications protocol:	TRAM-NET, 921Kbits/sec, similar to IEEE 802.3

Analog outputs (Tram-rac 4A only)

ECG (Tram):

Leads:	Traces one and two
Gain:	1 V/mV ± 10%
Range:	0.5 to 5 V
Frequency response:	0.05 Hz to 100 Hz

Respiration (Tram):

Lead:	Displayed lead
Gain:	1V / 1 Ohm
Range:	0.4 Ohm to 10 Ohms
Frequency response:	0.05 Hz to 2.2 Hz

Blood pressure (Tram):

Outputs:	Arterial BP, BP 2, BP 3, BP 4, signal ground
Gain:	10 mV/mmHg ± 4%
Frequency response:	DC to 50 Hz
Range:	-25 mmHg to 300 mmHg; 0 mmHg - 0.0V ± 0.025V

Pulse oximetry:

Outputs:	Value and waveform
Value gain:	10 mV / % saturation
Value range:	0 to 1 V
Waveform gain:	Fixed
Waveform range:	0 to 2.5 V
Frequency response:	DC to 50 Hz

Environmental specifications

Tram-rac 4A housing with optional power supply

Power requirements:	90 to 270 VAC, 50/60 Hz, single-phase
Power consumption:	70 Watts maximum, 40 Watts typical
Low-voltage shutdown:	85 VAC
Cooling:	Convection
Heat dissipation:	238 Btu/hr maximum (70 Watts)

Tram-rac 4A housing without optional power supply

Distance from Solar 8000i:	20 feet maximum
Power requirements:	16.76 V @ 3.5 A maximum

Tram-rac 2 and 4A housing

Operating temperature:	10°C to 35°C (50°F to 95°F)
Operating humidity:	40% to 95% (noncondensing)
Storage temperature:	-10°C to 50°C (14°F to 122°F)
Storage humidity:	0% to 95% (noncondensing)

Physical specifications

Tram-rac 2 housing

Height:	11.9 cm (4.7 in)
Width:	14.5 cm (5.7 in)
Depth:	31.2 cm (12.3 in)
Weight:	2.3 kg (5 lb)

Tram-rac 4A housing

Height:	22.9 cm (9.0 in)
Width:	14.5 cm (5.7 in)
Depth:	31.8 cm (12.5 in) without power supply 37.1 cm (14.6 in) with power supply
Weight:	2.7 kg (6 lb) without power supply 3.4 kg (7.5 lb) with power supply

Tram modules and Solar parameter functionality

Tram module processing

Main Processor:	Motorola 68000, 16/32 bit, 14.75 MHz
Input/Output Processor:	Intel 80C152, 8 bit, 14.75 MHz
Data Acquisition Processor:	Intel 80C152, 8 bit, 14.75 MHz
Sp02 Processor:	Intel 80C196, 8 bit, 7.3 MHz

ECG

Standard leads available:	I, II, III, V1 to V6, aVR, aVL, and aVF
Leads analyzed simultaneously:	Tram 451, 451M, 451N, 851, 851M, 851N: Twelve (I, II, III, V1 to V6, aVR, aVL, and aVF) All others: Four (I, II, III, and V1) in multi-lead mode
Lead fail:	Identifies failed electrodes and switches to intact one(s)
Lead fail sensing current:	Active electrodes: < 25 nA each, reference electrode: <200 nA
Waveform display aspect ratio:	0.46 sec/mV (amplitude = 12 mm/mV, length = 26 mm/sec) for a 25 mm/sec sweep rate displayed on a 17-inch diagonal display
Input specifications:	
QRS detection range:	±0.5 mV to ±5 mV
Signal width:	40 ms to 120 ms (Q to S)
Heart rate range:	30 to 300 beats per minute
Input impedance:	
Common mode:	>10 M at 50/60 Hz
Differential:	>2.5 M from dc to 60 Hz
Common mode rejection:	90 dB minimum at 60 Hz
Gain accuracy:	±5% (diagnostic mode)
Linearity deviation:	±5%
Noise:	<30 μV (referred to input)
Accuracy of the input signal reproduction	Overall System Error is tested using the method described in AAMI EC11 3.2.7.1. Overall System Error is +5%. Frequency Response is tested using the method described in AAMI EC11 3.2.7.2 methods A and D.
Modulating effects in digital systems	This device uses digital sampling techniques that may produce some variation in amplitudes of Q, R, and/or S waves from one heart beat to the next, which may be particularly noticeable in pediatric recordings. If this phenomenon is observed, the clinician should be aware that the origin of amplitude variations is not entirely physiologic. For measuring voltages of Q, R, and S waves, it is advisable to use the QRS complexes with the largest deflection of the particular waves.
Output specifications:	
Frequency response:	Tram 451, 451M, 451N, 851, 851M, 851N: Adult mode: 0.05 to 100 Hz OR mode: 0.05 to 25 Hz Neonatal mode: 0.5 to 40 Hz All others: 0.05 or 0.5 to 100Hz (user selectable)

Analog output:	Selectable at 1V/mV
Defibrillator sync/analog out delay:	<35 ms
Display:	
Standard mode:	0.05 to 40 Hz
OR Mode:	0.05 to 25 Hz
Neonatal Mode:	0.5 to 40 Hz
Laser Printer:	
Standard Mode:	0.05 to 100 Hz
OR Mode:	0.05 to 25 Hz
Neonatal:	0.5 to 40 Hz
Heart rate:	
Heart rate averaging:	8 Beats
Heart rate accuracy:	± 1% or ± 1 beat/minute, whichever is greater
Display update interval:	2 seconds
Response time:	< 6 seconds (per AAMI EC13)
Limit alarm delay:	< 10 seconds after limit alarm condition exceeded
Heart rate alarm range:	-1 to 300 beats/minute, high limit > low limit
Arrhythmia analysis:	1 to 100 PVCs/minute
Method:	QRS morphology classification and timing based on single- or multiple-lead analysis
Arrhythmia calls:	Full, lethal only, or no arrhythmia
PVC alarm limit range:	1 to 100 PVCs/minute
ST Segment analysis:	
Measurement description:	ST segment deviation is measured and displayed for all acquired leads
ST display:	Lead label, ST deviation, current complex superimposed over a reference complex, J-point indicator and 15-minute mini-trends are shown for all acquired leads
Measurement point:	Measured at user-selectable measurement points (0, 30, 40, 50, 60, and 80 ms) following the J point
Measurement range:	-12.0 mm to + 12.0 mm
Display resolution:	0.1 mm
ST measurement averaging:	16 beats
Display update interval:	2 seconds
ST alarm limits:	± 12 mm, high limit > low limit, for any event within a lead group (inferior, lateral or anterior) that exceeds the alarm limit for that group
Pacemaker detection/rejection:	
Input voltage range	±2 mV to ±700 mV
Input pulse width	0.1 ms to 2 ms
Rise time	10 μs to 100 μs
Over/under shoot	2 mV (maximum)

Baseline drift	<0.5 V with a ±700-mV, 2-ms pacemaker pulse applied
Lead fail:	Identifies failed lead
Detection/rejection mode:	'Pace 1' or 'Pace 2' pacemaker artifact rejection or 'Off'.
Pacemaker alarms:	none specific to pacemaker

Respiration

Respiration rate range:	1 to 200 breaths/minute
Respiration rate accuracy:	0 to 120 breaths/minute ± 1 121 to 200 breaths/minute ± 3
Impedance range:	100 to 1000 Ohms at 52.6 KHz
Detection sensitivity range:	0.4 to 10 Ohms impedance variation
Respiration rate alarm range:	1 to 200 breaths/minute
Apnea alarm range:	3 to 30 seconds
Waveform display bandwidth:	0.05 to 2.5 Hz (-3 dB)

Temperature (All modules)

Number of channels:	2
Probe type:	Series 400 or 700 (determined by input cable)
Temperature range:	0°C to 45°C (32°F to 113°F)
Parameters displayed:	T1, T2
Alarms:	User-selectable upper and lower limits for T1, T2
Accuracy:	±0.1°C (25°C to 45°C) independent of sensor
Display resolution:	±0.1°C

Invasive blood pressure
(Tram 451, 451M, 451N, 200SL, 400SL, 600SL, 250SL, 450SL, 650SL and 300 only)

Number of channels:	
Tram 451, 451M, 451N:	3/4 (4 available with Y-adapter cable)
Tram 200SL, 250SL:	2
Tram 400SL, 450SL:	3
Tram 600SL, 650SL:	4
Tram 300:	4
Transducer sites, site name and displayed values:	arterial (ART) - systolic, diastolic and mean femoral (FEM) - systolic, diastolic and mean pulmonary artery (PA) - systolic, diastolic and mean central venous pressure (CVP) - mean left atrial (LA) - mean right atrial (RA) - mean intracranial pressure (ICP) - mean umbilical arterial (UAC) - systolic, diastolic and mean umbilical venous (UVC) - mean special pressure (SP) - mean
Transducer requirements:	
Excitation voltage:	±2.5 V dc ±0.1%
Transducer output:	50 μV/V/cm Hg

Range:	–25 mmHg to 300 mmHg

Input specifications:	
Offset:	±150 mmHg
Input impedance:	
Common mode:	>100 K at 50/60 Hz
Differential:	>100 K from dc to 60 Hz
Output specifications:	
Gain:	976 ±1%
Frequency response:	dc to 50 Hz (+0/-3 dB)
Gain stability:	<±0.1%/°C, and <±0.1% over any 24 hour period
Zero balance range:	±150 mmHg
Zero balance accuracy:	±1 mmHg
Zero balance drift:	±1 mmHg over 24 hours
Common mode rejection:	>60 dB at 60 Hz
Noise:	<5 mV peak to peak from dc to 30 Hz
Accuracy:	±2% or ±1 mmHg, whichever is greater (exclusive of transducer)
Displayed frequency response:	0 to 12 Hz or 0 to 40 Hz (-3dB) user-selectable
Display scale selections:	0-30, 0-40, 0-60, 0-100, 0-160, 0-200, 0-300 mmHg
Analog output:	1 V / 100 mmHg
Alarms:	User selectable upper and lower limits for systolic, diastolic, and mean pressures; range -99 to 350 mmHg

Noninvasive blood pressure
(Tram 415, 451M, 451N, 851, 851M, 851N, 200SL, 400SL, 800A, 800SL, 250SL, 450SL, 850A, 850SL and 300 only)

Measurement technique:	Oscillometric
Displayed parameters:	Systolic, diastolic, and mean pressures, pulse rate, time of last measurement
Systolic pressure range:	
Adult:	30 to 275 mmHg
Pediatric:	30 to 240 mmHg
Neonatal:	30 to 135 mmHg
Diastolic pressure range:	
Adult:	10 to 220 mmHg
Pediatric:	10 to 200 mmHg
Neonatal:	10 to 110 mmHg
Mean pressure range:	
Adult:	20 to 260 mmHg
Pediatric:	20 to 235 mmHg
Neonatal:	20 to 125 mmHg
Cuff pressure range:	
Adult:	0 to 300 mmHg
Pediatric:	0 to 250 mmHg
Neonatal:	0 to 150 mmHg

Pressure accuracy:	
Static:	±2% or ±3 mmHg, whichever is greater
Clinical:	±5 mmHg average error 8 mmHg standard deviation
Measurement modes:	Manual, auto, and stat
Heart rate detection:	30 to 200 beats per minute
Total cycle time:	20 to 40 seconds typical (dependent on heart rate and motion artifact)
Maximum inflation pressure:	300 mmHg (adult), 250 mmHg (pediatric), 150 mmHg (neonatal)
Over-pressure valve:	Activates when cuff pressure exceeds: 300 mmHg (+30/-0 mmHg) adult, 150 mmHg (+15/-0 mmHg) neonatal
Automatic cycle times:	0 to 24 hours
Auto zero:	Zero pressure reference prior to each cuff inflation
Tubing length:	12 feet adult, 8 feet neonatal
Automatic cuff deflation:	Cycle time exceeding 2 minutes (85 seconds neonatal), power off, or cuff pressure exceeds 290 mmHg (± 6 mmHg) for adult, 250 mmHg (± 6 mmHg) for pediatric, or 145 mmHg (± 5 mmHg) for neonatal
Cuff sizes:	
Disposable:	Large adult, adult, small adult, pediatric, child, and neonatal
Reusable:	Adult thigh, large adult, adult, small adult, small adult/child, child, and infant
Alarms:	User-selectable upper and lower limits for systolic, diastolic, and mean pressures

Pulse oximetry
Tram 200SL, 400SL, 600SL, 800A, 800SL and 300 (support Ohmeda probes)
Tram 250SL, 450SL, 650SL, 850A and 850SL (support Nellcor and GE probes)

Parameters monitored:	Arterial oxygen saturation (SpO2) and peripheral pulse rate (PPR)
Probe types:	GE, Nellcor, Ohmeda.
Range:	
SpO2:	0 to 100%
PPR:	20 to 300 beats per minute (±3 beats per minute)

Accuracy:

90 to 100% SpO2:	1.5% (of overall range)
80 to 89.9% Sp02:	2.1%
60 to 79.9% Sp02:	2.4%
SpO2 < 60%:	unspecified
PPR	±1.7% of current reading (assumes constant pulse rate)
Displayed frequency response:	1.5 to 10.5 Hz
Analog output:	Selectable saturation 0 to 100% equivalent 0 to 1V
Alarm limit range:	SpO2: 0 to 105%; PPR: 0 to 350 beats per minute.
Messages sent to host:	Interference Detected, Low Light, Check Probe, Low Signal Quality, Probe Off Patient, Replace Bad Probe, Service the Module

Pulse oximetry
Tram 451 and 851 (support GE Medical Systems *Information Technologies*probes)
Tram 451M and 851M (support Masimo SET probes)
Tram 451N and 851N (support Nellcor Oxismart XL probes)

Parameters monitored:	Arterial oxygen saturation (SpO2) and peripheral pulse rate (PPR)
Probe types:	Tram 451, 851: GE Tram 451M, 851M: Masimo SET Tram 451N, 851N: Nellcor Oximart XL
Tram 451 and 851 range (GE):	
SpO2:	0 to 100%
PPR:	30 to 300 beats per minute
Tram 451M and 851M range (Masimo):	
SpO2:	30 to 100%
PPR:	25 to 240 beats per minute
Tram 451N and 851N range (Nellcor):	
SpO2:	1 to 100%
PPR:	20 to 250 beats per minute
Tram 451 and 851 accuracy (GE):	
90 to 100% SpO2:	±1.5% (of overall range)
80 to 89.9% SpO2:	±2.1%
60 to 79.9% SpO2:	±2.4%
SpO2 < 60%:	unspecified
PPR	±1.7% of current reading (assumes constant pulse rate)
Tram 451M and 851M accuracy (Masimo):	
70 to 100% SpO2:	Adult ±2, Neonatal ±3
69% or below SpO2:	Unspecified
PPR	±3 beats per minute
Tram 451N and 851N accuracy (Nellcor):	
Without motion:	
70 to 100% SpO2:	Adult ±2, Neonatal ±3
69% or below SpO2:	Unspecified
PPR	±3 beats per minute
With motion:	
70 to 100% SpO2:	±3
69% or below SpO2:	Unspecified
PPR	±5 beats per minute

Analog output:	Selectable saturation 0 to 100% equivalent 0 to 1V
Alarm limit range:	SpO2: 0 to 105%; PPR: 0 to 350 beats per minute.

Messages sent to host:

GE: *Pulse search, Poor signal quality detected, Probe is off patient, Probe or module malfunction*
Masimo: *Probe or module malfunction, Artifact detected, Probe is off patient, Low quality, Pulse search*
Nellcor: *Probe is off patient, Low quality, Pulse search*

Cardiac output

Method:	Thermal dilution
Cardiac output range:	0.2 to 15 liters per minute
Blood temperature range:	30°C to 42°C (86°F to 107°F)
Injectate temperature range:	0°C to 30°C (32°F to 86°F)
Waveform display frequency response:	0 to 10 Hz (-3 dB)
Output parameters:	Cardiac output, blood temperature, injectate temperature, real-time cardiac output waveform
Cardiac output review:	Accept / reject individual measurements and store average
Catheter sizes:	5, 6, 7, 7.5, 8, French
Injectate volume selection:	3, 5, 10 cc

Environmental specifications (all modules)

Power requirements:	16.75 VDC
Power consumption:	10 Watts (module alone)
Cooling:	Forced air
Heat dissipation:	Tram 451, 451M, 451N, 851, 851M, 851N: 34 Btu/hr All others: 31 Btu/hr
Operating temperature:	10°C to 35°C (50°F to 95°F)
Operating humidity:	40% to 95% (noncondensing)
Storage temperature:	-10°C to 50°C (14°F to 122°F)
Storage humidity:	0% to 95% (noncondensing)

Physical specifications (Tram modules)

Height:	8.1 cm (3.2 in)
Width:	11.4 cm (4.5 in)
Depth:	29.5 cm (11.6 in)
Weight:	2.1 kg (4.7 lb)

Dual temperature module (400 and 700 series)

Refer to the BP/CO/Temperature Modules Service Manual for Technical Specifications

Capnostat mainstream CO_2 module

Performance specifications

Information displayed:	Inspired and expired CO2 concentrations in %, mmHg or kPa; respiratory rate, continuous CO2 waveform
Measurement range:	Pi CO2/Fi CO2: 0 to 100 Torr / 0 to 13% Pe CO2/Fe CO2: 0 to 100 Torr / 0 to 13% RR: 0 to 120 breaths/min
Accuracy:	CO2 sensor accuracy: 0 to 40 mmHg ±2 mmHg; 41 to 100 mmHg 5% of reading
Display resolution:	1 mmHg
Respiration rate accuracy:	±1 breath/min
Rise time	
CO2 rise time:	Less than 60 msec
Compensations	
O2/N2O compensation:	Operator selectable
Barometric pressure compensation:	Manual as set in monitor
Technology	
Sensor:	Mainstream non-dispersive infrared (NDIR) absorption, dual wavelength ratiometric-true single beam optics
Calibration:	Simple one-step calibration (less than 20 seconds); no calibration gases required.
Alarms	
Type:	As set in monitor
CO2:	High inspired CO2; high/low expired CO2
Respiratory rate:	Adjustable high and low No breath detection system On screen obstruction alarm
Temporary silence:	60 sec
Reset:	Automatic
Cable length:	10 feet (3.04 m)
Construction:	Durable high performance plastic sensor with flexible cable
Shock resistance:	Sensor designed to withstand 6-foot (2 m) drops to a tile surface
Airway adapters	
Adult:	Reusable adult airway adapter, less than 5 cc dead space (pn 412341-001)
Low volume:	Reusable airway adapter, less than 0.5 cc deadspace (pn 412342-001)

Environmental specifications

Operating conditions

Ambient temperature:	15°C to 35°C (59°F to 95°F)
Relative humidity:	10% to 95% (noncondensing)

Storage conditions

Temperature:	0°C to 50°C (32°F to 122°F)
Relative humidity:	0% to 95% (noncondensing)

Physical specifications

Module

Height: 4.0 cm (1.6 in)	Depth: 28.6 cm (11.25 in)
Width: 11.4 cm (4.5 in)	Weight: 0.50 kg (1.11 lb)

Sensor

Height: 4.0 cm (1.60 in)	Depth: 2.2 cm (.87 in)
Width: 3.7 cm (1.45 in)	Weight: <28 grams (<1 oz)

SvO_2 module

Performance specifications

Display

Display:	SvO2, a-vO2, three asterisk signal strength indicator and help messages
Messages:	Warming Up, Calibration Takes Up to 60 Seconds, Do Light Calibration, Light Intensity Calibration, Preinsert Calibration Fail, Damped Intensity, High Intensity, Low Intensity, Blood Gas Calibration Fail, Draw Blood, Waiting for Blood Gas.

Processing

SvO2 range:	0% to 100%
Response time:	90% response to oxygen saturation step function in 5 sec. Oxygen saturation computed each second from 5 second running average of light intensity measurement
SvO2 accuracy:	±2% oxygen saturation ±1 standard deviation over 40% to 100% range
Stability:	Drift <2% oxygen saturation over 24 hours
Data acquisition rate:	244 sets of samples/sec

Alarms

Type:	Audible and visual

Environmental specifications

Operating conditions

Ambient temperature:	10°C to 35°C (50°F to 95°F)
Relative humidity:	40% to 95% (noncondensing)

Storage Conditions

Temperature:	-10°C to 50°C (14°F to 122°F)
Relative humidity:	0% to 95% (noncondensing)

Physical specifications

Height: 4.1 cm (1.6 in)	Depth: 28.6 cm (11.2 in)
Width: 11.4 cm (4.5 in)	Weight: 0.50 kg (1.11 lb)

ICG module

Performance specifications

Measurement Range

Cardiac Output (CO):	0 to 30 L/min
Cardiac Index (CI):	0 to 15 L/min/m^2
Stroke Volume (SV):	0 to 250 mL
Stroke Index (SI):	0 to 125 mL/m^2
Acceleration Index (ACI):	0 to 400 1/100s^2
Thoracic Fluid Content (TFC):	10 to 150 1/kΩ
Pre-Ejection Period (PEP):	0 to 1000 milliseconds
Left Ventricular Ejection Time (LVET):	0 to 1500 milliseconds
Systolic Time Ratio (STR):	0 to 1
Velocity Index (VI):	0 to 200 1/1000s
Systemic Vascular Resistance (SVR):	0 to 5000 dyne·sec·cm^{-5}
Indexed Systemic Vascular Resistance	0 to 10,000 dyne·sec·cm^{-5}/m^2
(SVRI):	0 to 200 g·m/m^2
Left Stroke Work Index (LSWI):	0 to 25 kg·m/m^2
Indexed Left Cardiac Work (LCWI):	40 to 250 beats/min
Heart Rate (HR):	

Power requirements

Maximum Power Consumption:	+16.5 volts, 610 mA
(non-isolated)	+5.0 volts, 135 mA

Environmental specifications

Operating Conditions	Refer to the monitor specifications.
Storage Conditions	
Temperature:	–40°C to +70°C (–40°F to +160°F)
Relative Humidity:	0 to 95% (non-condensing)
Altitude:	-305 to 3353m (-1000 to 11,000ft.)
Atmospheric Pressure:	645 to 795mmHg (860 to 1060hPa)

Physical specifications

Height:	4.0 cm (1.6 in)
Width:	11.4 cm (4.5 in)
Depth:	28.6 cm (11.25 in)
Weight:	1.0 kg (2.2 lb) maximum
Cooling Method:	Forced Air
Heat Dissipation:	9W maximum

Compatible host monitors, Tram-racs

Host Monitor/Tram-rac	Software Version
Solar 7000:	7A or later
Solar 8000:	7A or later
Tram-rac 4A:	6A or later

Warranty One year (accessories may differ)

BIS/EEG module

Performance specifications

Measurement Range

Suppression Ratio (SR):	0.0-100.0% (in 0.1% steps over the last 63 seconds)
Spectral Edge Frequency (SEF):	0.50-30.00 Hz @ 95% in 0.01 Hz steps
Median Frequency:	0.50-30.00 Hz @ 50% in 0.01 Hz steps, DSC4 only
Bispectral Index (BIS):	0-100.0 in 0.1 steps, DSC3 only
Total Power (TOTPOW):	0-100.0 dB in 0.01 dB units where 0 dB = 0.0001 mV^2
Electromyogram (EMG):	0.0-100.0 dB in 0.01 dB units where 0 dB = 0.0001 mV^2
Signal Quality Index (SQI):	0.0-100.0% in 0.1% steps

EEG Waveforms

Number of channels:	BIS DSC: 1 or 2 channels EEG DSC: 1, 2 or 4 channels
Sampling rate:	Normal mode: 128 or 256 sps

Transmission of EEG waveforms may be enabled or disabled with a software command.

Filter options for filtered EEG waveforms sent to host monitor (256 samples/second only)

Normal mode	High-pass: 0.25, 1.0, 2.0 Hz Low-pass: none, 30, 50, 70 Hz Notch: none, 50, 60, 50 & 60 Hz

Power requirements

Maximum Power Consumption	+16.5V, 300mA
(non-isolated	+5V, 2mA

Environmental specifications

Operating Conditions	Refer to the monitor specifications.
Storage Conditions	
Temperature:	–40°C to +70°C (–40°F to +140°F)
Relative Humidity:	0 to 95% (non-condensing)
Altitude:	–305 to 1830m (–1000 to 6,000ft.)
Atmospheric Pressure:	645 to 795mmHg (860 to 1060hPa)

Alarm specifications

Alarm Limit Range:	BIS: –1 to 100
Type:	Audible and visual

Physical specifications

Height:	4.0 cm (1.6 in)
Width:	11.4 cm (4.5 in)
Depth:	28.6 cm (11.25 in)
Weight:	0.52 Kg (1.15 lb)
Cooling Method:	Natural convection
Heat Dissipation:	20Btu/Hr (6W), maximum

Warranty One year (accessories may differ)

Patient Data Module

Refer to the Patient Data Module service manual for technical specifications.

Solar SpO_2 Masimo SET module

Refer to the Solar SpO_2 Masimo SET Module service manual for technical specifications.

Solar 8000M/i display

The Solar 8000M/i patient monitor is currently available with the following GE displays:

- 15-inch, medical-grade, digital flat panel display with touchscreen
- 15-inch, medical-grade, analog/digital flat panel display with or without touchscreen
- 19-inch, medical-grade, analog/digital flat panel display with or without touchscreen

Off-the-shelf (non-medical grade) displays are also compatible (see the required and recommended specifications in this appendix).

WARNING
Do not connect a monochrome display to the Solar 8000M/i patient monitor. Visual alarm messages may not appear properly.

WARNING
Use of non-GE displays with the Solar 8000M/i monitor may result in loss of visual alarms and patient monitoring. Display functionality must be verified for proper operation with the Solar 8000M/i patient monitor in the clinical environment prior to placing into service.

Purchaser's responsibility

The display purchaser is responsible for meeting Solar 8000M/i display specifications. GE does not make recommendations regarding specific display models other than those it offers for sale. For questions regarding display specifications or compatibility of displays not purchased from GE, contact the display manufacturer.

The GE warranty only applies to equipment purchased from GE. Service repairs resulting from failures of equipment not purchased from GE are billable.

NOTE
An isolation transformer must be used with a computer-grade display to meet UL and EN specifications.

Medical-grade displays

The Solar 8000M/i patient monitor with a medical-grade display meets applicable UL and IEC specifications for a medical electrical system. For this system, an isolation transformer is not required.

Non-medical grade displays

The Solar 8000M/i patient monitor with a non-medical grade display meets UL and IEC specifications *if* an isolation transformer is used, regardless of whether the computer-grade display meets the leakage current specification on its own.

The party assembling or modifying the medical electrical system is responsible to insure compliance with IEC 60601-1-1. Therefore, if GE installs a Solar 8000M/i system with a computer-grade display, GE is responsible for meeting the specification.

As a result GE will only install non-medical grade displays with appropriate isolation transformers. (See the following information.)

Isolation transformers

Powervar has designed an isolation transformer specifically for this application. Powervar headquarters (listed below) will process orders and drop-ship to any destination requested. When calling Powervar, identify yourself as a GE representative/customer to receive the GE partnership discount.

Powervar
28457 North Ballard Drive, Suite C
Lake Forest, Illinois 60045
Phone: 847-816-8585
Fax: 847-816-8988

Contact your local sales/service representative for part numbers and unit information.

Required specifications for non-medical grade CRT displays

The following are *required* specifications:

Electrical:		
Horizontal:	Sync Rate:	48.4 KHz (*see note)
	Sync Input:	TTL negative
Vertical:	Refresh Rate:	60 Hz (*see note)
	Sync Input:	TTL negative
Video:	Non-composite:	0.7Vp-p analog RGB
	Polarity:	Black-negative
	Resolution:	1024 x 768
	Input Impedance:	75 ohms

NOTE

Multiscan displays indicate the sync rate and the refresh rate as ranges (e.g., 20 KHz to 80 KHz), rather than a single value. To meet the required specifications, ensure that the ranges indicated on your display include a 48.4 KHz horizontal sync rate and a 60 Hz vertical refresh rate.

Monitor (Display) Connections:	
Captive cable, or interconnect cable (processor unit to display):	
	15 pin (3 row) Dsub male connector, standard VGA pinout
Connector(s):	15 pin (3 row) Dsub female connector, standard VGA pinout; or 5 BNC connectors
Emissions:	CISPR 22
Agency Approvals:	IEC 60950-1, UL 60950-1, CAN/CSA-C22.2 No. 60950-00, CE

See "Non-medical grade displays" on page A-23.

Recommended specifications for non-medical grade CRT displays

The following are *recommended* specifications:

Monitor (Display) Size:	12-inch to 19-inches typical
Input Voltage Range:	90-254 VAC 50/60 Hz
Controls:	On/Off, Brightness, Contrast
Environmental:	
Operating Temperature:	10 to 40 degrees C
Humidity:	10 to 95% (non-condensing)
Bandwidth:	60 MHz minimum
Dot Pitch:	0.28 mm maximum
Misconvergence:	0.3 mm maximum
Non-linearity/Geometric Distortion:	2% maximum
Luminance:	>40 foot-lamberts at screen center with 20% white screen
CRT:	Anti-glare coating and transmissiveness of approximately 57%
Mounts:	If the monitor (display) will be mounted, it must accommodate GCX or equivalent mounting GCX Corporation 3875 Cypress Drive Petaluma, CA 94954 707-773-1100

Required specifications for non-medical grade digital flat panel displays

The following are *required* specifications:

Electrical:		
Horizontal:	Sync Rate:	48.4 KHz (*see note)
	Sync Input:	TTL negative
Vertical:	Refresh Rate:	60 Hz (*see note)
	Sync Input:	TTL negative
Video:	TMDS Digital Video DFP 1.0 Compliant	
	Resolution:	1024 x 768

NOTE

Multiscan displays indicate the sync rate and the refresh rate as ranges (e.g., 20 KHz to 80 KHz), rather than a single value. To meet the required specifications, ensure that the ranges indicated on your display include a 48.4 KHz horizontal sync rate and a 60 Hz vertical refresh rate.

Monitor (Display) Connections:	
Captive cable, or interconnect cable (processor unit to display):	
	20 pin mini-D ribbon (MDR) male connector
Connector(s):	20 pin mini-D ribbon (MDR) female connector
Emissions:	CISPR 22
Agency Approvals:	IEC 60950-1, UL 60950-1, CAN/CSA-C22.2 No. 60950-00, CE

See "Non-medical grade displays" on page A-23.

Recommended specifications for non-medical grade digital flat panel displays

The following are *recommended* specifications:

Monitor (Display) Size:	15-inch to 21-inches typical
Display Characteristics:	Viewing angle ± 70° horizontal minimum; ± 70° vertical minimum
Input Voltage Range:	90-135 VAC/60 Hz, or 180-270 VAC/50 Hz
Controls:	On/Off, Brightness
Environmental:	
Operating Temperature:	10 to 40 degrees C
Humidity:	10 to 95% (non-condensing)
Bandwidth:	65 MHz minimum
Contrast Ratio:	300:1 typical
Brightness:	150 nits minimum
Protective Filter:	Anti-glare hard coat
Mounts:	If the monitor (display) will be mounted, it must accommodate GCX or equivalent mounting GCX Corporation 3875 Cypress Drive Petaluma, CA 94954 707-773-1100
Agency Approvals:	Refer to "Non-medical grade displays" on page A-23

B Appendix B – Electromagnetic compatibility

Electromagnetic compatibility (EMC)

Changes or modifications to this system not expressly approved by GE can cause EMC issues with this or other equipment. This system is designed and tested to comply with applicable regulation regarding EMC and must be installed and put into service according to the EMC information stated in this supplement.

CAUTION
Use of portable phones or other radio frequency (RF) emitting equipment near the system may cause unexpected or adverse operation.

CAUTION
The equipment or system should not be used adjacent to, or stacked with, other equipment. If adjacent or stacked use is necessary, the equipment or system should be tested to verify normal operation in the configuration in which it is being used.

Guidance and manufacturer's declaration — electromagnetic emissions

The Solar 8000M/i is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or user to assure that the Solar 8000M/i is used in such an environment.

Emissions test	Compliance	Electromagnetic environment – guidance
RF Emissions (radiated) EN 55011	Group 1 Class A	The equipment uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF Emissions (conducted) EN 55011	Group 1 Class A	**CAUTION** The equipment is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic Emissions EN 61000-3-2	Class A	
Voltage Fluctuations/ Flicker Emissions EN 61000-3-3	Complies	

Guidance and manufacturer's declaration — electromagnetic immunity

The Solar 8000M/i is intended for use in the electromagnetic environment specified below. It is the responsibility of the customer or user to assure that the Solar 8000M/i is used in such an environment.

Immunity test	EN 60601 test level	Compliance level	Electromagnetic environment – guidance
Electrostatic Discharge (ESD) EN 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical Fast Transient/Burst EN 61000-4-4	± 2 kV for power supply lines ±1 kV for input/output lines	± 2 kV for power supply lines ±1 kV for input/output lines	Mains power should be that of a typical commercial or hospital environment.
Surge EN 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines EN 61000-4-11	<5% U_t (>95% dip in U_t) for 0.5 cycles <40% U_t (>60% dip in U_t) for 5 cycles <70% U_t (>30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5 s	<5% U_t (>95% dip in U_t) for 0.5 cycles <40% U_t (>60% dip in U_t) for 5 cycles <70% U_t (>30% dip in U_t) for 25 cycles <5% U_t (>95% dip in U_t) for 5 s	Mains power should be that of a typical commercial or hospital environment. If the user of the equipment requires continued operation during power mains interruptions, it is recommended that the equipment be powered from an uninterruptible power supply or a battery.
Power Frequency (50/60 Hz) Magnetic Field EN 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

NOTE

U_t is the AC mains voltage prior to application of the test level.

Immunity test	EN 60601 test level	Compliance level	Electromagnetic environment – guidance
			Portable and mobile RF communications equipment should not be used closer to any part of the equipment, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance**
Conducted RF EN 61000-4-6	3 Vrms 150 KHz to 80 MHz	3 V rms	$d = 1.2\sqrt{P}$
Radiated RF EN 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = 1.2\sqrt{P}$ 80 MHz to 800 MHz $d = 2.3\sqrt{P}$ 800 MHz to 2.5 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer, and *d* is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol:

Note 1: At 80 MHz and 800 MHz, the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by reflection from structures, objects, and people.

[a]Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the equipment is used exceeds the applicable RF compliance level above, the equipment should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the equipment.

[b]Over the frequency range 150 KHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended separation distances

The table below provides the recommended separation distances (in meters) between portable and mobile RF communications equipment and the Solar 8000i.

The Solar 8000M/i is intended for use in the electromagnetic environment on which radiated RF disturbances are controlled. The customer or the user of the Solar 8000M/i can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the Solar 8000M/i as recommended below, according to the maximum output power of the communications equipment.

	Separation distance in meters (m) according to frequency of transmitter		
Rated maximum output power of transmitter in Watts	**150 kHz to 80 MHz** [a] $d = 1.2\sqrt{P}$	**80 MHz to 800 MHz** [a] $d = 1.2\sqrt{P}$	**800 MHz to 2.5 GHz** [a] $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23
[a]At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.			

For transmitters rated at a maximum output power not listed above, the recommended separation distance [d] in meters (m) can be estimated using the equitation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE

These guidelines may not apply in all instances. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Compliant cables and accessories

CAUTION
The use of accessories, transducers and cables other than those specified may result in increased emissions or decreased immunity performance of the equipment or system.

The table below lists cables, transducers, and other applicable accessories with which GE claims EMC compliance.

NOTE
Any supplied accessories that do not affect EMC compliance are not included.

Category	Description	Maximum length
ECG Cables		
	Multi-Link 12-Ld ECG Standard Cable	3.6 m / 12 ft
	Multi-Link 5-Ld ECG Standard Cable	6 m / 20 ft
	Multi-Link 3-Ld ECG Neonatal Cable	3.6 m / 12 ft
	Multi-Link 3-Ld ECG Cable w/Grabber	3.6 m / 12 ft
	Multi-Link 5-Ld ECG ESU	3.6 m / 12 ft
	Multi-Link, 3/5-Ld ECG Cable	3.6 m / 12 ft
	Multi-Link 3-Ld Neonatal ECG Cable	3.6 m / 12 ft
	Multi-Link 3-Ld ECG Cable w/Grabber	3.6 m / 12 ft
	Multi-Link 6-Ld ECG Cable	3.6 m / 12 ft
	Multi-Link 12SL ECG Cable	3.6 m / 12 ft
	Multi-Link 3/5/6 Adapter	N/A
	Multi-Link to 300-Series 3-Ld Trunk Cable	3 m / 10 ft
	Multi-Link to 300-Series 5-Ld Trunk Cable	3 m / 10 ft
ECG Multi-Link leadwires		
	Multi-Link leadwire Set-Group, 5-Ld, Grabber	130 cm / 51 in
	Multi-Link leadwire Set-Group, 3-Ld, Grabber	130 cm / 51 in
	Multi-Link leadwire set, 5-Ld, Grabber	130 cm / 51 in
	Multi-Link leadwire set, 5-Ld, Grabber V2-V6	130 cm / 51 in
	Multi-Link leadwire set, 3-Ld, MiniGrab AHA Ld I	74 cm / 29 in
	Multi-Link leadwire set, 3-Ld, MiniGrab IEC Ld I	74 cm / 29 in
	Multi-Link leadwire set, 3-Ld, Adult Grabber AHA Ld II	74 cm / 29 in

Category	Description	Maximum length
	Multi-Link leadwire set, 3-Ld, Adult Grabber IEC Ld II	74 cm / 29 in
	Multi-Link Ldwr Set-Group, 5-Ld, Snap	130 cm / 51 in
	Multi-Link Ldwr Set-Group, 3-Ld, Snap	130 cm / 51 in
	Multi-Link Ldwr Set, Mini-Clip/DIN, Neonatal	60 cm / 24 in
	Multi-Link Ldwr Set, 5-Ld, Snap	130 cm / 51 in
	Multi-Link Ldwr Set, Radiotranslucent Grabber	1.6 m / 60 in
	Multi-Link Ldwr Set, 6-Ld, Snap	130 cm / 51 in
	Multi-Link Ldwr Set, Individual, Grabber	130 cm / 51 in
	Multi-Link Ldwr Set, Individual, Snap	130 cm / 51 in
	Multi-Link Ldwr Set, Individual, Grabber, V2-V6	130 cm / 51 in
	300-Series 3-Ld Set w/clips	75 cm / 30 in
	300-Series 3-Ld Set w/clips	1.5 m / 60 in
	300-Series 3-Ld Set w/snaps	75 cm / 30 in
	300-Series 5-Ld Set w/clips	125 cm / 49 in
	300-Series 5-Ld Set w/clips	1.5 m / 60 in
	300-Series 5-Ld Set w/snaps	125 cm / 49 in
	300-Series replacement clip lead	125 cm / 49 in
	300-Series replacement clip lead	1.5 m / 60 in
	300-Series replacement clip lead	75 cm / 30 in
	300-Series replacement snap lead	125 cm / 49 in
Invasive BP cables and transducers		
	Utah Transducer Adapter Cable	3.6 m / 12 ft
	Spectramed Transducer Adapter Cable	3.6 m / 12 ft
	Dual BP adapter	30 cm / 12 in
	Utah Transducer Adapter Cable	3.6 m / 12 ft
	Abbott Transpac-III Adapter Cable	3.6 m / 12 ft
	Abbott Transpac-IV Adapter Cable	3.6 m / 12 ft
	Edwards Truwave Adapter Cable	3.6 m / 12 ft
	Spectramed Transducer Adapter Cable	3.6 m / 12 ft
	Utah Disposable Transducers (DPT, DP2, DP3)	N/A
	Spectramed Transducers (TC-MQ)	N/A
	Abbott Transpac-III Transducers	N/A

Category	Description	Maximum length
	Abbott Transpac-IV Transducers	N/A
	Edwards Truwave Transducers (PX)	N/A
Cardiac output cables and probes		
	Cardiac Output Cable	3.6 m / 12 ft
	Cardiac Output Probe	2.4 m / 8 ft
	Cardiac Output Cable	3.6 m / 12 ft
Temperature cables and probes		
	Dual Temp Cable	20 cm / 8 in
	Temp Probe Interconnect Cable	3.6 m / 12 ft
	Dual Temp Cable	20 cm / 8 in
Pulse oximetry cables and sensors		
	Nellcor RECAL Interface Cable	3.6 m / 12 ft
	Masimo SET Interface Cable	3.6 m / 12 ft
	Masimo SET Interface Cable	3.6 m / 12 ft
	Nellcor RCAL Interface Cable	3.6 m / 12 ft
	Nellcor OxiMax Interface Cable	3 m / 10 ft
	Masimo Finger Sensor, Pediatric	N/A
	Masimo Finger Sensor, Adult	N/A
	Masimo Sensor Finger Probe	N/A
ICG cable		
	ICG Patient Cable	4.8 m / 15 ft
BIS/EEG cables		
	BIS DSC w/PIC Plus	N/A
	EEG DSC w/leadwires	N/A
	EEG DSC Extension Cable	6 m / 20 ft
TC cable		
	Radiometer E5280 Patient Cable	N/A
SvO_2 cable		
	Abbott Optical Module	N/A
CO_2		
	CO_2 Sensor Cable	2.4 m / 8 ft
Accessories		

Category	Description	Maximum length
	TRAM Modules	N/A
	Transcutaneous (TC) Module	N/A
	SvO_2 Module	N/A
	MGAIR Sidestream CO_2 Module	N/A
	Capnostat Mainstream CO_2 Module	N/A
	BIS/EEG Module	N/A
	SpO_2 Module	N/A
	SAM Module	N/A
	ICG -BIOz Hemodynamics Module	N/A
	Masimo SET Pulse Oximetry Module	N/A
	Dual Temperature Module	N/A
	Dual BP Module	N/A
	Tram-rac Series	N/A
	Unity Network ID	N/A
	Respiratory Mechanics Module	N/A
	PRN 50 Printer	N/A
	TRAM-NET Cable	7.6 m / 25 ft
	RJ45 series Category 5 cable	N/A
	Remote Control	N/A
	Key Pad	N/A
	Serial Cable	25 ft
	Power Cord	2.4 m / 8 ft
	Digital Video Cable	1.8 m / 6 ft
	Touch Cable RS232	1.8 m / 6 ft
	Analog Video Cable	1.8 m / 6 ft
	18-inch Medical Grade Flat Panel Display	N/A
	15-inch Medical Grade Flat Panel Display	N/A
	15-inch Medical Grade Flat Panel Display	N/A
	15-inch Medical Grade Flat Panel Display with Touch	N/A

Category	Description	Maximum length
	15-inch Medical Grade iPanel Computer	N/A
	Keyboard (USB)	N/A
	Mouse (USB optical)	N/A
	PS2 Y Adapter Cable	N/A
	Kit, HHP 3800PDF USB Scanner with USB Cable	N/A
	3800PDF Scanner Cable (USB, Type A)	10 ft.

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